

**Working Memory and Attention in
Alcoholic Korsakoff's Syndrome:
A Pilot Study.**

**A thesis submitted in fulfilment of a Master of Arts degree
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Abstract

Two males with a suspected diagnosis of Alcoholic Korsakoff's Syndrome (AKS) were recruited along with two age, education-matched alcoholic controls and two comparable non-alcoholic controls. The AKS subjects were recruited on the basis of a history of alcohol abuse and anecdotal evidence to suggest memory impairment. Psychometric testing (WAIS-R, WMS-R and the NART) provided evidence to suggest that one subject was probably AKS while in the other the diagnosis was unlikely. Divided attention within the context of Baddeley's (1992) model of working memory was investigated with a modified Brown-Peterson task, in which a range of distracters were used. A task that involves sustained attention, Inspection Time, was also employed to assess whether the alcoholic subjects had a global attention impairment. The release from proactive interference task was employed as it is suggested that the Brown-Peterson impairments and failure to release from proactive interference seen in some cognitively impaired alcoholics, particularly AKS patients are due to a common underlying pathology (involving frontal lobe dysfunction).

While the sample was too small to make any strong conclusions, it is suggested that cognitive dysfunction as a result of alcohol abuse, and not AKS per se, may be a factor in the impaired performance in the Brown-Peterson task. Overall performance in the release from PI was poor in the two suspected AKS subjects. The present study also highlights problems obtaining "clinically diagnosed" AKS subjects and sufficient numbers to warrant group-based experimental work.

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Chapter 1

1.1 Background

In the late nineteenth century Sergei Korsakoff reported an amnesic syndrome which was characterised by early confabulatory symptoms and a persistent severe amnesia that was disproportionate to other impairments in cognitive functioning. At the time this syndrome was not primarily attributed to alcohol ingestion or malnutrition per se, as other factors were present, such as vomiting and typhoid fever. The symptoms were attributed to a presence of a toxic substance that had an effect on the central nervous system (CNS) and the peripheral nervous system (PNS). Earlier, Carl Wernicke had described a syndrome that included ataxia, optic abnormalities and a confusional state. These symptoms had been present in two alcoholics (and one person with sulfuric acid poisoning, which had led to excessive vomiting) (Butters & Cermak, 1980; Victor, Adams, & Collins, 1989). Although Korsakoff had mentioned oculomotor and gait disturbances in some patients (Kopelman, 1995), it was not known at the time that these two syndromes were linked by a common pathology and that one often preceded the other in what is now identified as Wernicke-Korsakoff's Syndrome.

It has since been established that a deficiency of thiamine (vitamin B1) produces Wernicke's disease, that this syndrome may be followed by Korsakoff's Syndrome and that they are stages of a single disease (Victor et al., 1989). Korsakoff's Syndrome has two aetiologies: 1. a result from alcohol abuse and malnutrition (which is more common in Western society) or, 2. from malnutrition only.

1.1.1 The Wernicke phase in Korsakoff's Syndrome

The major symptoms of the Wernicke's phase incorporate one or a combination of the following: global confusion, time and place disorientation, problems recognising familiar people, apathy, inattentiveness, difficulties in holding coherent conversation, eye disturbances (ophthalmoplegia, nystagmus, abducens and conjugate gaze palsies), ataxia and a polyneuropathy of legs and arms (Butters & Cermak, 1980; Victor et al., 1989). Victor et al. (1989) state that the term Wernicke's encephalopathy (WE) should be applied to this symptom complex when the persistent deficit in learning and memory is not present. In the acute Wernicke's phase high doses of B1 combined with abstinence from alcohol can arrest and even reverse the symptoms. The irreversible Korsakoff's Syndrome phase is reached usually after 2-3 weeks from the onset of the acute Wernicke's phase (Butters & Cermak, 1980). When a patient presents with symptoms of WE and persistent amnesia they are considered to possess Wernicke-Korsakoff's Syndrome (Victor et al., 1989).

There is evidence, however, to suggest that the Wernicke stage does not always proceed Korsakoff's Syndrome. A study reported by Martin, Adinoff, Weingartner, Murherjee and Eckardt (1986) found that only 46% of patients with alcoholic chronic organic brain syndrome (Korsakoff's Syndrome) had a history or clinical features of WE. This was substantiated by Blansjaar and van Dijk (1992) who carried out a longitudinal study of 44 Korsakoff's patients and found that only 18% of the patients had been diagnosed as having either WE or Wernicke-Korsakoff's Syndrome. Hence the concept that WE (or symptoms of it) *always* precedes Korsakoff's Syndrome is probably inaccurate. However, Victor et al. (1989) suggest that misdiagnosis is often present in such cases and that rather than there being an absence of WE, the symptoms were either not observed or recorded. They found strong evidence to support the notion that WE *always* precedes Korsakoff's Syndrome, in 96% of the cases they studied symptoms of

WE were present. Blansjaar and van Dijk (1992) do not exclude the possibility that the symptoms of WE were present but were undetected, although this seems unlikely as they reviewed each patient's medical history and examined the patients for residual effects of WE.

Throughout the present study the symptom complex outlined by Victor et al. (1989), Wernicke-Korsakoff Syndrome, will be referred to Alcoholic Korsakoff's Syndrome (AKS), as the present study is only concerned with Korsakoff's Syndrome resulting from both alcohol abuse and thiamine deficiency. For the present study, the term Alcoholic Korsakoff's Syndrome also incorporates patients who may not have exhibited symptoms of WE.

1.1.2 Alcoholic Korsakoff's Syndrome

Alcoholic Korsakoff's Syndrome (AKS) is characterised by a loss of memory function (anterograde and retrograde amnesia), strictly speaking against a background of relatively normal intellectual functioning. Anterograde amnesia is the most prominent feature, with patients having very poor ability to learn new information (especially verbal information) from the time of onset (Cermak & Butters, 1972). Retrograde amnesia is also a consistent feature of this syndrome, in that patients have trouble recalling long term memory events (recent and remote memories) that occurred prior to the onset of AKS (Butters & Cermak, 1980). Victor et al. (1989) point out that the degree of memory impairment in AKS patients is variable.

Amnesia is not the only cognitive deficit present in AKS patients but it is the most prominent feature of it. Patients can have a number of other secondary deficits, such as visuospatial and visuoperceptive deficits, difficulty formulating plans and problem solving, (Butters & Cermak, 1980), problems with emotional affect (apathy and social indifference, superficial and labile emotions, and lack of goal oriented spontaneous activity) (Martin et al., 1986; Victor et al., 1989). They

also have impairment on tasks involving divided attention (Talland, 1965). There is disagreement over which deficits are “core” features of the disease and which are additional deficits that may be present in some but not all AKS patients.

1.1.3 Problems of definition and diagnosis

As already mentioned the symptoms of WE are often missed or incorrectly diagnosed. Further to this, Harper, Giles and Finlay-Jones (1986) reviewed 131 cases (a majority of which were chronic alcoholics) in which AKS was diagnosed at necropsy (on the basis of past medical history and documentation of associated AKS clinical “signs” e.g., poor memory and ataxia), and found that **80%** of these cases had not been diagnosed as AKS during their lifetime. They also found that in 19% of patients with AKS diagnosed post-mortem there has been no documentation of any mental deficiency. Blansjaar, Vielvoye, van Dijk, and Rijnders (1992) used Magnetic Resonance Imaging (MRI) techniques on five AKS patients and five chronic alcoholics. They found that, while AKS patients had a severe memory impairment (as determined by WMS and WAIS differences) compared to the chronic alcoholics, the MRI revealed lesions (atrophy of the mamillary bodies, diencephalon and cerebellum) in both groups with equal frequency. This suggests that the lesions specific to AKS or WE may be present before the subsequent symptoms manifest, which may explain why diagnosis is often missed only to be discovered at autopsy.

In the 1970s, a prominent notion was that alcoholism and AKS were two distinct disorders, on the assumption that AKS developed from thiamine deficiency and that, as alcohol had no obvious deleterious effects on the nervous system, alcoholics in general did not have any concerns about brain dysfunction as long as they adhered to a nutritionally balanced diet (Butters, 1985). Studies have since refuted this idea because alcohol has been shown to have a toxic effect on the brain (see Page, 1982, for a review). In addition, support comes from studies reported by Oscar-Berman (1980; 1984); she found that cognitive deficits seen in

long-term alcoholics (without AKS) were often similar to, but less severe to those seen in AKS patients. Thus AKS may not develop acutely from thiamine deficiency alone but may develop slowly over a long period of time due to the toxic effects of alcohol.

Chronic alcoholics with cognitive dysfunction can usually be divided into two distinguishable groups based on the diverse signs of brain impairment exhibited in such patients: 1. Alcoholic Dementia, which is characterised by global intellectual decline, abstracting ability and problem solving deficits, dysphasias and apraxias, EEG abnormalities, cerebral atrophy and ventricular dilation, and 2. AKS as described above (Martin et al., 1986). Jacobson and Lishman (1987) report that while the degree of memory impairment and the loss of cognitive function is variable in AKS patients, the distinction between AKS and Alcoholic Dementia is justified, although they admit that the distinction between the two is not always clear.

By contrast, Longmore and Knight (1988) found that alcohol demented and AKS patients performed at similar levels on tasks involving divided attention and interference effects (Brown-Peterson paradigm and release from proactive interference.) Although only four Alcoholic Dementia patients were examined this study suggested that performance on such tasks is independent of IQ functioning and that the underlying pathology for tasks involving divided attention/interference effects may be the same for both populations. Victor et al. (1989) also disagree that Alcoholic Dementia and AKS are separate entities as there has been a failure to establish a pattern of cognitive impairments specific to Alcohol Dementia that are separate from those seen in AKS, indicating the need for more research to establish what deficits may be specific to both conditions.

1.1.4 Continuity Hypothesis

Central to the above argument was the idea that cognitive deficits associated with alcohol abuse and AKS are part of a continuum. This idea was termed the Continuity Hypothesis (Ryback, 1971), in which AKS followed by Alcoholic Dementia is at one end of a cognitive performance continuum (indicating severe cognitive impairment) and the heavy social drinker at the other (normal cognitive performance). The hypothesis predicted that the degree of cognitive impairment was determined by drinking history, measured by quantity, duration and frequency (Ryback 1971; Martin et al., 1986). However, it is important to note that there are often confounding factors such as head trauma from falls as a result of alcohol intoxication. Also the type of brain damage that occurs as a result of chronic abuse varies and is due to a number of influences: genetics, gender, starting age, quantity consumed per session, number of sessions, type of alcohol consumed, diet, abstinence (Page, 1982; Oscar-Berman, 1990) and degree of cortical atrophy (Jacobson, Acker & Lishman, 1990).

AKS and alcoholism are now generally viewed as two distinct disorders because the cognitive deficits seen in AKS patients, especially their amnesia, is qualitatively different or generally much more severe than those seen in alcoholics, and the Continuity Hypothesis does not account for these differences. However, alcohol is believed to have some adverse affect on the brain structure and function, probably through direct neurotoxicity (Butters, 1985).

It is uncertain, which of the deficits associated with AKS are attributable to thiamine deficiency and those that are a result of alcohol toxicity. There is evidence to suggest that AKS may involve cortical processes, particularly the frontal lobe. Talland (1965) noted that AKS patients were often apathetic, lacked spontaneity and initiative, had a loss of insight, preservation and impairment of planning, which are also exhibited in patients with frontal lobe disorders. Jacobson et al. (1990) suggest that the aetiology of AKS requires: 1. thiamine

deficiency resulting in diencephalic damage, and defective episodic memory, and

2. other features associated with alcoholism (cortical and subcortical atrophy) which may contribute to some aspect of global intellectual impairment.

1.2 Biological factors

1.2.1 Diencephalon damage

AKS is associated with symmetrical lesions of the third and fourth ventricles and the aqueduct, including diencephalic damage to the mamillary bodies and the midline and anterior nuclei of the thalamus. Victor et al. (1989) found that the medial nucleus of the thalamus was the most consistent diencephalic structure damaged (38/43 cases), although the relative contributions of the medio-dorsal nucleus of the thalamus, the anterior thalamic nuclei and the mamillary bodies to memory function is still undecided (Aggleton & Sahgal, 1993). These diencephalic lesions are largely a consequence of thiamine deficiency resulting from the long term effects of large quantities of alcohol (Butters, 1985; Martin et al., 1986).

As the type and location of lesions differ across AKS patients, it is difficult to locate precisely the biological basis for diencephalic amnesia as major neurotransmitter pathways are also disrupted. The lesions to diencephalic structures coincide with the regions of monoamine containing neuron pathways, particularly norepinephrine (NE) pathways, which a number of investigators have implicated in memory. This observation has been the basis of a number of neuropharmacological studies exploring neurotransmitter involvement and potential drug therapy in this disorder. Before discussing the influence of NE pathways in AKS and associated behavioural/cognitive deficits (see section 1.2.3.) the important contribution of possible frontal lobe dysfunction is briefly considered.

1.2.2 Frontal lobe pathology

Evidence for the involvement of the cortical processes, in particular the frontal lobes comes from two sources: 1. CT studies where it has been shown that AKS patients have some degree of cortical atrophy, and widening of cortical sulci (Jacobson & Lishman, 1987; Ron, Acker & Lishman, 1980), 2. From behavioural studies linking cognitive performance in AKS patients to those with frontal lobe damage (e.g., Squire, 1982).

AKS patients perform poorly on the Wisconsin Cart Sorting Test (WCST) which reflects frontal lobe processing capacities (Squire, 1982; Joyce & Robbins, 1991) and the Category Sorting Test (CST), which is an adaptation of the WCST (Jacobson et al., 1990). They also have increased susceptibility to interference (proactive interference), poor memory for temporal order, difficulty in using imagery mnemonics and confabulation (Moscovitch, 1982) and deficits in verbal fluency (Jacobson et al., 1990). Poor release from proactive interference in AKS patients has been related to low scores on three frontal lobe tests, namely the WCST, word fluency and embedded figures tasks (Squire, 1982). Kopelman (1995) reported three case studies of AKS patients (who showed moderate-severe impairments in tasks of retrograde memory) where 2/3 had severe impairment of a task sensitive to frontal lobe dysfunction (FAS - verbal fluency task).

Oscar-Berman (1984) states that the underlying pathology of AKS is complex and appears to involve a multitude of connections to various areas of the brain, including the frontal lobes (and temporal lobes). The pre-frontal cortex is believed to be involved in the delayed response task and the delayed alternation task in non human primates and damage to this region interferes with short term memory, spatial memory, distractibility and disinhibition, which are comparable to deficits seen in AKS. Several studies (in which Oscar-Berman, 1984 was a author) also found that the prefrontal cortex was involved in attention and arousal in AKS. She notes that no single theory has adequately accounted for all the

cognitive functions that may involve the frontal lobe function (especially the prefrontal cortex).

From a brief overview of the literature it is apparent that the underlying neuropathology is complex and involves a number of critical structures in the diencephalon, as well as associated neurotransmitter pathways, (which is outlined in more detail below), and also some degree of cortical involvement. The discrepant findings indicate that the structures damaged in AKS vary in terms of location and degree of damage and it still remains unclear exactly how diencephalic damage is related to the cognitive impairments in AKS. However, it is generally believed that the memory deficits associated with AKS are primarily due to damage to the medial diencephalon and the visuoperceptive and problem solving deficits are due to some form of association cortex damage (Butters, 1985). This view, however, is too simplistic, given the performance of many AKS patients on frontal lobe tests and working memory tasks which indicate additional frontal lobe dysfunction.

1.2.3 Neuropharmacology

While not the focus of the present study, it is important to outline briefly the neurotransmitter deficits, in particular norepinephrine deficits as NE loss has been associated with memory impairment and is related to attention and arousal function in AKS patients (and in animals). Work in this area provides more information as to the extent of brain damage in AKS, and is an important part of understanding the cognitive deficits associated with AKS, particularly attention.

Victor et al. (1989) reported that the locus coeruleus (LC) and the dorsal motor nucleus of the vagus, locations of the A6 and A2 catecholamine containing cell groups, are lesioned in a majority of cases. The LC, located in the 4th ventricle, contains the largest collection of NE cell bodies, and has afferents

which pass through the diencephalon to the neocortex, thalamus, hippocampus and basal forebrain (McEntee & Mair, 1984).

Not all researchers, however, agree that there is neuronal loss from the LC in AKS. Halliday, Ellis and Harper (1992) found that (from post-mortem studies) AKS patients did not differ in the overall number of LC cells compared with controls (although they did note that the amount of LC degeneration in AKS patients varied considerably). LC cells are known to degenerate as a result of the aging process, and while it is recognised that with age (and the majority of AKS patients are over 50) memory declines along with neurotransmitter loss, evidence strongly suggests that people with AKS have deficits above and beyond “normal” age associated memory impairment (McEntee & Crook, 1989).

The biochemical studies that implicate NE in Korsakoff’s syndrome were undertaken by McEntee and Mair (1978, 1983) and Mair, McEntee and Zatorre (1985) who found that Cerebral Spinal Fluid (CSF) of AKS patients contained significantly deficient levels of 3 Methoxy-4-Hydroxyphenylglycol (MHPG), the primary monoamine metabolite of NE, and that there was a significant correlation between the severity of the patients memory impairment and the levels of MHPG in the CSF. Further support for the theory that NE is depleted in AKS comes from additional research by McEntee and Mair (1980) and Mair and McEntee (1986) who demonstrated that administration of clonidine, an alpha-2 adrenergic agonist, can improve the memory of AKS patients, particularly anterograde memory performance (including performance on the Brown-Peterson task.) They acknowledge that clonidine may improve attention and arousal in AKS patients as opposed to directly affecting memory mechanisms in part because significant improvements were seen on the Stroop test also.

However, NE may not be the only deficient neurotransmitter involved in AKS. Adrendt, Bigl, Adrendt and Tennstedt (1983) found that there was up to a 47% loss of cholinergic neurons from the nucleus basalis of Meynert (which is the

main source of cholinergic to the cortical mantle) in AKS patients (and up to a 70% loss in Alzheimer patients). However, Mair, Anderson, Langlais and McEntee (1985) outline 4 major reasons why the NE deficient hypothesis of AKS is favoured. 1. the appropriate NE rich areas of the brain (e.g., the LC) are lesioned in a large number of AKS patients, 2. concentration of CSF MHPG is consistently reduced in AKS compared with controls, 3. cognitive deficits can be improved by administration of clonidine and, 4. there are similarities in behavioural deficits in animals associated with manipulations of NE activity and behavioural deficits found in AKS patients.

1.2.4 The role of NE and attention

It has been suggested that NE (and other catecholamines) have an important role in attention. Arnsten and Contant (1992) suggest that the prefrontal cortex (PFC) plays a role in attention regulation. Brickner (1934, in Arnsten & Contant, 1992) found that patients with frontal lobe lesions were often easily distracted, inattentive and had poor concentration. They also state that performance the Stoop test is subserved by the PFC and this may explain why the clonidine studies by Mair and McEntee found significant improvements in AKS patients on this test, as the principal sulcus of the prefrontal cortex has connections to the medial dorsal nucleus of the thalamus and the LC. Mair and McEntee (1986) suggest that that alpha-2 adrenergic receptors in these sites may play a role in clonidine's amelioration of some cognitive deficits associated with AKS. They hypothesise that the impairment of cognitive function in AKS patients is related to diminished NE activity and that this in turn is a factor in the attention and information processing deficits in these patients. In addition Wilkins, Shallice & McCarthy (1987) found that patients with lesions to the PFC had poor sustained attention.

1.3 Direction of this research

From the above considerations there is some evidence from neurobiological and pharmacological studies in humans and animals to suggest that there may be an attention deficit in AKS patients. The present experiment focused on the attentional problems that may exist in AKS, particularly within the context of the Brown-Peterson task (which involves maintenance rehearsal and divided attention) and from the theoretical perspective of Baddeley's (1992) model of working memory. In addition, performance on a second attention task that involved sustained attention (Inspection Time) was also evaluated. Damage to the frontal lobes (in particular the PFC) is implicated in the expression of attention deficits. Another task, release from PI and the failure to do so in AKS patients is also suggested to be related to frontal lobe damage. Performance by AKS patients on this task will also be evaluated.

1.4 Working memory

Working memory is regarded as a limited capacity system that involves the simultaneous storage and processing of information, and is a complex elaboration of the earlier notions of short term memory. Baddeley (1994) describes a definition of working memory as follows:

"Working memory" may be defined as the system for the temporary maintenance and manipulation of information necessary for the performance of such complex cognitive activities as comprehension, learning and reasoning. (p. 351)

Digit span, a test of immediate memory, is not usually impaired in AKS (Victor et al., 1989; Knight & Longmore, 1994). However, another immediate memory task, the Brown-Peterson paradigm, often produces an impairment in AKS (although there are some inconsistencies in the literature, which will be discussed below.) Baddeley (1992) proposed a theoretical model that serves as an

explanatory framework in which to understand the findings in working memory literature. This model has proved useful (at least in part) to explain some of the working memory deficits seen in various clinical/amnesic populations. In the present study performance in the Brown-Peterson task is interpreted within the context of this model.

1.4.1 Baddeley's Model of Working Memory

Baddeley's (1992) model of working memory is a tripartite system which consists of a central executive (CES) or attention controller and two subsidiary slave systems that supplement the central executive - the Articulatory or Phonological Loop and the Visuospatial Sketch Pad. The Articulatory Loop is assumed to be responsible for maintaining speech based information and is considered to be defective in patients with STM impairments (Baddeley, 1993). The Visuospatial Sketch Pad is assumed to perform the function of setting up and manipulating visuospatial imagery.

The CES is presumed to be a form of limited capacity attentional system, which controls activities through the allocation of attention resources, regulates the activity of the slave systems and assists in the retrieval of information from LTM. A major assumption of the model is that one of the primary functions of the central executive is the co-ordination of information processed by the slave systems (Baddeley, 1993). Thus the central executive is principally concerned with the integration of information and the control of action, particularly when we are engaged in non-routine or demanding tasks. When the demands of a task are high the CES becomes more heavily involved, co-ordinating additional resources to help maintain the information in working memory. In the case of divided attention tasks, the demands of the task often exceed the resources available and performance begins to decline. However, Baddeley (1994) himself admits that the exact function of the central executive is elusive: "The central executive is the

most important but least well understood component of working memory.” (p.360).

Baddeley (1992) modelled the CES on the basis of the control of action as proposed by Norman and Shallice (1980) in which this function is performed by a hypothetical Supervisory Attention System (SAS). The SAS model proposes that there are two ways of controlling ongoing action. 1. Contention scheduling, where routine activities are controlled by existing schemata and different routine actions are co-ordinated, which is independent of SAS control. 2. The SAS overrides contention scheduling when required, as for example in novel situations, for unexpected events or when the demands on attention are high (e.g., problem solving). Norman and Shallice (1980) propose that behavioural deficits like those seen in patients with frontal lobe damage may reflect a deficit in the SAS. In fact this system was formulated to explain the poor allocation of attention (in some tasks) in people with frontal lobe damage. Thus deficits in frontal lobe function may reflect a problem in the SAS or CES. Due to the conceptual overlap between the SAS and Baddeley's CES it is presumed that the latter is also impaired when frontal lobe functions are compromised. This proposal remains a preliminary one, however, as other researchers (e.g., Morris, 1994) suggest that a dysexecutive syndrome, at least in Alzheimer's disease, may reflect a more widespread disconnection of the association cortex throughout the brain.

1.4.2 The Brown-Peterson Paradigm

The Brown-Peterson Paradigm involves the presentation of three letters or words (the to-be-remembered items), followed by a retention interval of varying lengths (usually up to 20 seconds) in which the subject is required to perform some sort of demanding distracter task. The classic distraction is to count backward from 100 in threes, at which point the subject is required to recall the to-be-remembered items in the correct order. As stated by Crowder (1982, p.

295), the Brown-Peterson task captures an everyday experience: “momentary distraction and the subsequent loss of very recent information.”

It is thought that the distracter task prevents the subject from rehearsing properly, and one major reason why this may cause forgetting is that the distracter uses up central processing resources that would otherwise be used to rehearse the to-be-remembered items (Morris, 1986). A demanding distracter task in the Brown Peterson paradigm may occupy a sufficient proportion of the resources of the central executive so that maintenance rehearsal is severely disrupted.

There is strong evidence to suggest that Korsakoff’s Syndrome patients are abnormally sensitive to interference manipulations such as the Brown-Peterson paradigm (Cermak, Butters & Goodglass, 1971; Cermak & Butters, 1972; Butters & Grady, 1977; Butters & Cermak, 1980; Butters, 1985; Longmore & Knight, 1988; Leng & Parkin, 1989). However, there is also some evidence that AKS patients are not impaired in the Brown-Peterson task. Kopelman (1985) compared Alzheimer patients, AKS patients and controls’ performance on this task. He found that while Alzheimer patients had a severe deficit in short term memory tasks as manifested by Brown-Peterson performance (and poor digit span), the AKS patients had a small (non significant) impairment on the Brown-Peterson (and normal digit span) task in comparison to controls. This lack of impairment in the Brown-Peterson paradigm is supported by other research (Baddeley & Warrington, 1970; Mair, Warrington & Weiskrantz, 1979; Warrington, 1982). However, Cermak, Butters and Goodglass (1971) argue that Baddeley and Warrington (1970) had a 4 second predistracter period prior to the onset of the distracter task, possibly giving their subjects adequate time to transfer the to-be-remembered items to LTM. This is supported by Butters and Grady (1977) who found that even predistracter intervals of only 3 seconds significantly enhanced recall. In addition, the distracter task often employed has been less demanding than the usual counting backwards in threes distracter, for example, Baddeley and Warrington (1970) required their subjects to only count backwards

in ones, and this may be less sensitive in detecting impairments in AKS patients. However, despite the different methodologies used it is still generally agreed that there is a lot of variability in AKS performance on this task (see Kopelman, 1994).

The neurodegenerative disorder, Alzheimer's Disease, often produces many (though usually more severe) memory impairments similar to AKS (Delis, Massman, Butters, Salmon, Cermak & Kramer, 1991). Of particular relevance to the present research, Morris (1986) investigated abnormal interference in Alzheimer's patients using the Brown-Peterson paradigm. The purpose of Morris' experiment was to investigate whether the poor performance on the Brown-Peterson paradigm in Senile Dementia of Alzheimer's Type patients (SDAT) is due to a reduction in central processing resources, which leads to an impairment in the efficiency of maintenance rehearsal, using Baddeley's working memory model as a conceptual basis for examining the effects of a range of distracter conditions. In Morris' first experiment, he investigated three types of distracter tasks, all thought to use differing amounts of central processing resources:

1. articulation (articulatory suppression) - during the retention interval the subject was required to repeat aloud the word "the" over and over again. This was considered to occupy the phonological loop but only use a small amount of resources,
2. digit reversal - the subject was presented with two digits and she or he was required to reverse them, and
3. digit addition - the subject was given two digits and was required to add them together.

The latter two distracters were considered to be relatively more demanding on central processing (executive) resources. These three distracter task conditions were compared to unfilled retention intervals across 0, 5, 10, and 20 second delays. Morris found that SDAT patients and elderly controls showed minimal

forgetting in the unfilled condition, but in the articulation condition the two groups diverged with the SDAT patients exhibiting a poorer performance. An even more pronounced impairment in SDAT patients occurred in the digit reversal and digit addition conditions. In a second experiment, Morris found that even a simple non-verbal distracter task (finger tapping) produced significant forgetting in SDAT patients compared with controls. The combined results suggest that even very simple verbal and non verbal distracter tasks are enough to disrupt short term retention of verbal material for SDAT patients, possibly because SDAT patients have faulty maintenance rehearsal due to a severe reduction in their central processing resources (work has shown that the phonological loop subsystem is unimpaired in SDAT patients; Morris & Baddeley, 1988). The suggestion is that Alzheimer patients' reduced resources are insufficient for these patients to cope with simultaneous demands of even a simple distracter task and rehearsal of the to-be-remembered items.

Given the many similarities in memory impairments between Alzheimer's patients and AKS patients, the pattern of results shown by Morris (1986) might also occur perhaps to a lesser degree in AKS, especially as AKS patients also generally exhibit abnormal interference in the Brown-Peterson task. That is, it is possible that AKS patients, like Alzheimer's patients, have a reduction in "central processing resources" that can be explored in the context of Baddeley's (1992) working memory model. By varying the types of distracter tasks it should be possible to vary the demand on a potentially already faulty central executive of AKS patients and thus their forgetting rate should increase in comparison to controls as rehearsal demands increase during the retention interval (controls should have enough central processing resources to cope with the demands of both tasks in the retention interval).

Kopelman (1994) reviewed the literature on working memory in AKS (and Alzheimer's) and suggested that the variable Brown-Peterson performance found in the literature was probably related to the degree of cortical atrophy seen

in AKS. While Leng and Parkin (1989) argue for frontal lobe pathology, Kopelman (1985, 1991b) suggests that atrophy of the right and left hemisphere in AKS patients accounts for deficits found on verbal and non verbal tasks, rather than specifically the frontal lobes. Kopelman (1994) states that the role of the central executive and performance on such dual tasks including the Brown-Peterson paradigm has been studied on several occasions with Alzheimer's patients, but little research has been done to examine the role of the central executive in amnesic patients. He reports a study by Meudell, Mayes and Macdonald (1994) who used a letter detection task in conjunction with a semantic decision task in organic amnesic patients (including three AKS patients). They demonstrated that their amnesic patients were impaired in the dual task situation (compared to healthy controls) but not either task when administered separately.

Thus there is only preliminary evidence to suggest that performance in dual-task situations, which involve the CES, are impaired in AKS patients and more research in this area is needed to establish the relationship between working memory, the central executive and attention in AKS patients.

1.5 Proactive Interference

A second feature of the cognitive impairments associated with AKS is a failure to release from proactive interference (PI). The task requires learning a list of words from a particular category, for example, types of fruits. Over a repetition of different lists, recall often declines as previously seen words from the same category interfere with the list currently being learnt. This is termed 'proactive interference' because past learning interferes with new learning. Release from PI occurs when the list category is changed, demonstrated by an increase in recall. Patients with frontal lobe lesions characteristically show poor release from PI (Moscovitch, 1982), and a similar failure is shown in AKS patients (e.g., Squire, 1982). Freedman and Cermak (1986), however, found that only AKS patients with frontal lobe lesions and memory deficits failed to release from PI, indicating

that lesions to the frontal lobe plus a degree of memory impairment is essential for this phenomenon to occur.

Some studies have found no impairment in the release from PI in AKS patients, but usually when unusual conditions were employed or performance levels were problematic. Winocur, Kinsbourne and Moscovitch (1981) found that AKS patients could show release from PI only after a second taxonomic shift was introduced or if the shift was made more salient by a change in the colour of the words or background (on which the words were printed). Kopelman (1991b) found that AKS patients were not abnormally impaired on the release from PI task despite showing a moderate impairment on other frontal lobe tests. However, he only presented three lists before the shift was introduced (instead of the usual four) and this may have meant that there was not a sufficient build up of PI to suppress release in AKS patients. Longmore and Knight (1988) found that their AKS and Alcohol Dementia patients failed to show any build up of PI and hence release or failure to release could not be exhibited.

Nonetheless, there is variability in AKS patients' performance on this task. This variability may reflect their degree of frontal lobe damage, as suggested by Moscovitch (1982) and Squire (1982), although Kopelman (1991b) found no evidence that release from PI task was related to performance on specific frontal lobe tests.

1.6 Methods of measuring attention

In their review of studies of attention in Alzheimer patients, Parasuraman and Haxby (1993) outline three areas of attention research: selective attention, divided attention and sustained attention. They note that selective attention has received the most interest and work on sustained attention the least. As a divided attention task, the Brown-Peterson has already been discussed and performance in AKS patients interpreted as a possible dysfunction of the central executive. A related question of the present study was whether attentional deficits in AKS

patients are limited to just one aspect of attention (divided attention) or whether more general deficits might be observed in other attentional domains. Of particular interest, was an example of sustained attention and speed of information processing.

Sustained or focused attention, characterised by vigilance tasks, usually involves some form of discrimination or detection of a stimulus that is somewhat infrequent or unpredictable over a period of time and is related to but not the same as alertness/arousal. Vigilance is defined as the “accuracy or speed in detecting an unpredictable target” (Parasuraman & Haxby, 1993 p. 255). Research in this area has suggested that mild Alzheimer patients have a deficit in sustained attention under effortful processing conditions. That is, they can perform comparably with controls on sustained attention tasks when the task demands are low, but this performance declines (in comparison to controls) when more effort is required (Parasuraman & Haxby, 1993). Victor et al. (1989) provided anecdotal evidence that AKS patients are unable (or perhaps unwilling) to apply themselves to tasks that involve sustained mental activity, but there is little empirical information on their performance in sustained attention tasks.

Parasuraman and Haxby (1993) discussed studies that implicate subcortical nuclei such as the locus coeruleus in both selective and sustained attention in Alzheimer’s disease. As discussed earlier, the LC is often damaged in AKS suggesting that AKS patients may also show impairment in sustained attention tasks. In the present study sustained attention and the speed of information processing were evaluated using an Inspection Time task.

1.7 Inspection Time

Inspection Time is defined as the time it takes a subject to accurately discriminate between a two choice stimulus presentation (Deary, Hunter, Langan & Goodwin, 1991). Typically, this involves the subject discriminating between two parallel lines of different lengths, which is followed by a backward mask indicated by longer lines of equal length. The task is made harder by shortening the time between the presentation of the stimulus and the onset of the mask.

The processes underlying Inspection Time involves several factors: a perceptual component, the rate of information processing of a simple stimulus, and attentional factors, particularly sustained attention. There is a moderate negative correlation between IT and IQ of around -0.5 (higher IQ subjects have faster IT times) in “normals” (Deary et al., 1991). This correlation is higher when the subjects are intellectually disabled (Nettlebeck, 1987).

Egan and Deary (1992) used a computerised IT task involving the discrimination between two lines of light of different lengths. This task employed the Parameter Estimation by Sequential Testing (PEST) algorithm which establishes IT from an individual's performance when they can accurately discriminate between the stimuli 85% of the time. They found that in “normals” performance on an IT task was not affected when processing demands were increased by the requirement of the subjects to perform the Paced Auditory Serial Addition Task (PASAT) concurrently. As the PASAT is a demanding task, this result suggests that IT performance may yield a measure of vigilance that is relatively independent of processing load at least in a “normal” population.

In a study that was similar to an IT task, Oscar-Berman and colleagues (Oscar-Berman, 1980) investigated visual information processing deficits in AKS, in particular the time it took for AKS patients, alcoholic and non alcoholic controls to accurately identify a stimulus shown at brief intervals presented via a tachistoscope. The presentation of the stimulus was followed by backward mask,

and time between the presentation of the stimulus and the onset of the mask (duration of presentation of the first stimulus; interstimulus interval) was varied. They found that on average AKS patients' needed almost double the stimulus-mask interval (for correct identification of the target) as the non alcoholic controls (alcoholic controls showed intermediate performance). This suggests that AKS patients may have (visual) information processing and vigilance deficits.

Deary et al. (1991) explored the more standard IT task of Egan and Deary (1992) in AKS patients, Alzheimer patients, and age and pre-morbid IQ-matched controls. Interestingly, they found that the AKS patients performed similar to controls, while the Alzheimer patients' performance was significantly worse. It is not surprising that Alzheimer patients' performance was impaired considering the IQ-IT relationship, which is higher in intellectually impaired patients (see above). However, the exact nature of AKS patients' performance is problematic in this case; IQ (as tested by the Cattell Culture Fair Intelligence Test) correlated -0.55 with IT for the controls, -0.59 for the Alzheimer's but only -0.32 for the AKS patients. The AKS patients performed significantly worse than the control subjects on this test of IQ, (questioning the validity of these subjects as being "pure" AKS patients).

The present study used the IT task and IT algorithm designed by Barrett and Eysenck (personal communication with P. Barrett, 1995) termed BRAT (which is a tongue in cheek reply to the term PEST). BRAT is considered to provide a more precise and direct measure of IT than PEST. Whereas the PEST algorithm establishes IT from an individual's performance at the point when they can accurately discriminate between the stimuli 85% of the time, BRAT employs a more complex method of establishing IT. The BRAT technique involves three phases: Phase 1 is a quick estimate of IT, Phase 2 refines the IT established in Phase 1, and in Phase 3 the trials continue (within the IT duration set by phase 1 and 2) until 9 consecutive correct responses at a particular duration are recorded then an IT is assigned. BRAT also uses smaller intertrial intervals (a fixed 0.2

second intertrial interval plus an additional 0.5-1.5 seconds between a warning beep for the up coming display and actual stimulus display) than PEST (on average 4 seconds) and so is an extremely fast paced procedure demanding sustained attention both on task in any trial and across trials within any session. However, it should be noted that neither Deary et al.s' nor Barrett's IT task places any emphasis on reaction time, in fact subjects are encouraged to take as long as they want to respond. Finally as the BRAT algorithm employs a smaller step size decrease in stimulus duration than PEST the former task allows a more accurate IT measure to be obtained.

Thus two different tasks have produced conflicting evidence as to whether AKS patients are impaired on two different examples of IT performance (Oscar-Berman, 1980; Deary et al. 1991). IT performance in the standard task comparable to that used by Deary et al was investigated in the present study using the refined computerised IT version (BRAT), which may be more accurate in determining any differences between AKS patients and controls than PEST. It is assumed that BRAT has a large attention/concentration component especially when the duration of the stimulus is brief and the decision process is critical. What is of interest is whether sustained attention is impaired in AKS patients in comparison to age and IQ matched controls. If a subject has a problem processing information quickly and focusing attention in the IT task, IT should be longer and more errors should be made with a longer time needed to establish that IT.

1.8 The present study

In the present study there were major difficulties in obtaining a respectable sample size. This was in part due the restructuring of the mental health system within New Zealand, which has meant that the majority of AKS patients have been relocated from institutionalised care into the community, making it almost impossible to locate them. This problem was exacerbated by the introduction of the Privacy Act in 1993, which has made it harder to obtain

information regarding diagnosis and location of such subjects (this will be discussed further in Chapter 4).

For the above reasons only two alcoholic patients (with an unconfirmed diagnosis of AKS) could be recruited. These two patients were suspected primarily on anecdotal evidence as being AKS. Psychological measures were employed (WAIS-R, WMS-R and NART) to assist in the evaluation of a diagnosis of the AKS patients. These patients were compared with two matched alcoholics controls, who showed no clinical signs of cognitive dysfunction, plus two comparable non-alcoholic controls.

The aim here was to explore attentional problems that may exist in AKS patients, in particular from the perspective of Baddeley's model of working memory and following the methodology of Morris (1986) who employed the Brown-Peterson task. It was postulated that CES deficits reflected in limited attentional resources play a role in the memory impairment on the Brown-Peterson task seen in AKS patients. It is suggested that the "dysexecutive syndrome" seen in Alzheimer patients may reflect frontal lobe damage (although this is somewhat speculative), if this is the case then AKS patients (who often have frontal lobe damage) may also exhibit the "dysexecutive syndrome".

An additional attention task involving sustained attention (Inspection Time) was also employed. The reasoning behind this choice was to see if AKS patients had additional attention deficits aside from the possible divided attention deficit seen on the Brown-Peterson task. If sustained attention ability is impaired in AKS then they should perform poorly on the IT task.

The present study also investigated release from PI as failure to do so is also a deficit often seen in AKS patients. Performance on this task has been associated with frontal lobe dysfunction. It is suggested that if the underlying processes in the release from PI and Brown-Peterson task are the same (e.g., involve some degree of frontal lobe dysfunction) then it would be expected that the AKS patients' performance in these tasks would be impaired comparatively on

both tasks (and in comparison to the alcoholic controls and non-alcoholic controls).

Six case studies are presented comparing performance in the Brown-Peterson task, release from PI task and IT task in two possible AKS patients, to two alcoholic controls and two non-alcoholic controls. In order to establish how AKS patients perform relative to these control subjects. The present study is designed as pilot work primarily as a basis for future group-based experimental work.

Chapter 2

Method

2.1 Subjects

All subjects were males aged 53-60 years. There were two subjects with suspected AKS, two age, gender, education and IQ matched alcoholic controls and two comparable non alcoholic controls. Details concerning each subject are presented, as case studies in Chapter 3, where experimental data are also reported.

The inclusion criteria for the AKS patients were as follows: 1. a history of alcohol abuse and reported memory loss. A history of WE was not a prerequisite as there is often limited medial information to verify this and evidence suggests that WE may not always precede AKS, 2. no history of major head trauma, or any other psychological disorder other than those associated with alcoholism, 3. no evidence of dementia, 4. not currently taking any medication that may interfere with cognitive performance, and 5. alcohol free for at least one month (the decision about 4 was made in conjunction with Dr Ken Fox, Psychiatric Service for the Elderly, Sunnyside Hospital, Christchurch). The possible AKS subjects were recruited from a long term residential alcohol treatment centre in Christchurch (Nova Lodge). Both subjects signed an informed consent form in conjunction with a caregiver (the manager of the treatment centre) who also

signed on their behalf (see Appendix A for copies of the information sheets and consent forms).

Two alcoholic controls were recruited from the same alcohol treatment centre. They signed consent forms on their own behalf (see Appendix A). They had no evidence of AKS, but otherwise the inclusion criteria were the same as the AKS patients.

The two male non-alcoholic subjects were paid \$50 for their participation in the study. Neither had a history of alcohol abuse or any other significant psychological disorder (initially three were recruited, but one had experienced a major head trauma and was subsequently dropped from the sample.) They signed the same consent forms as the alcoholic controls (refer Appendix A).

2.2 Standard psychological measures

Measures of intellectual functioning (IQ) was obtained using the Wechsler Adult Intelligence Scale-Revised (WAIS-R); memory functions were evaluated using the Wechsler Memory Scale-Revised (WMS-R); and the level of premorbid IQ was estimated using the National Adult Reading Test (NART). It is recognised that the NART is an imperfect measure of pre-morbid IQ (O'Carroll, Moffoot, Ebmeier, & Goodwin, 1992), but the ease of administration and lack of demographic variables available across the subjects in the present study made the NART the best option to estimate pre-morbid IQ. All tests were administered and scored as per standard instructions.

2.3 Release from Proactive Interference

2.3.1 *Materials*

Three lists from the following categories were used: animals, occupations, and countries. The lists were generated from Johansson and Hofland's (1989) word frequency analysis. The word frequencies were based on the Lancaster-Oldo/Bergen (LOB) Corpus, which is comprised of a million word collection of present day British English texts, including novels (e.g. science fiction and mystery) and sections of various British newspapers, such as editorials and reviews. The words are homograph-separated (i.e., they are separated according to word class, e.g., separate frequencies are given for the word "fast" as an adjective, adverb, noun and verb).

For the present study only noun frequencies of the above categories were used to generate the lists. In each category list, 45 words were generated from a large category list derived from the LOB Corpus and these words were balanced for word frequency and readability. The categories were randomly assigned to each condition (shift and no shift) and each subject was presented the same list (in the same order) in each of the conditions (see Appendix B for the lists of words actually used in each category). The words were 1 cm in height, in bold uppercase 48 point Times font, and printed onto 21 cm by 5.5 cm cards.

2.3.2 Procedure

Two conditions were employed: a no shift condition and a shift condition. In the shift condition, 4 lists of 9 words were presented from one category (occupations), then, on the fifth list, 9 words from a second category (countries) were used. In the no shift condition 5 lists each comprising of 9 words from a third category (animals) were presented. The shift and no shift conditions were administered in separate sessions (the no shift condition was presented in the first session).

The subjects were asked to read each word aloud, to try and remember each one then to recall as many words as possible from the list when a card with “?” was presented. Each word was exposed for 3 seconds. The instructions given and further details of the procedure are provided in Appendix C.

All responses were recorded regardless of whether they were correct or not. The mean percentage correctly recalled per list was obtained for each subject as well as intralist and extralist intrusion errors.

2.4 Brown-Peterson Task and distracter conditions

2.4.1 Materials

A list of 120 consonant trigrams (CCC) were taken from Constanini and Blackwood's (1968) list of 343 CCC. This list originated from the lowest letters-word-phrase association values (0-17% list) of Witmer's (1935) CCC list of association-values, which Constanini and Blackwood (1968) had re-evaluated. In

the present study, 55 CCC were taken from Constanini and Blackwood's 0-20% association value list, 51 from the 21-40% value list and 14 from the 41-60% value list. The final list was chosen by checking over Constanini and Blackwood's (1968) list for any CCC that had any association either relevant to New Zealand (e.g., any combination of ZK which is an aircraft based registration) or which had recently attained some association (such as MHz, Mega Hertz). An additional 10 CCC were taken from Constanini and Blackwood's (1968) list for use in the practice trials. The CCC were 1 cm in height printed in bold uppercase, 48 point Times font, centred on 10.5 cm by 5.5 cm cards.

The order of the 120 CCC, the National Adult Reading Test (NART) and the order of the retention intervals were pseudo-randomly arranged (high association CCC were mixed in with low association, so that in no distracter condition were there only high or low association CCC; for the delays, no retention interval was repeated twice in a row). Refer to Appendix D for the list of CCC used in each condition.

2.4.2 Procedure

Standard delays of 0, 3, 9, and 18 seconds were employed. Five distracter conditions were used, four of which were based on Morris' (1986) study (the no distracter, tapping, articulation, and digit reversal) plus the standard counting backwards in threes.

There were 6 trials per retention interval (including the 0 delay) and for each distracter condition, thus 24 trials per condition and 120 trials in total.

Testing was spread over two sessions. During each session 12 trials of the no distracter condition preceded any other condition. In the first session, the no distracter condition was followed by two sequential distracter conditions of 24 tapping trials and 24 trials of counting backwards in threes. In the second session, the final 12 trials of the no distracter condition were followed by the articulation and digit reversal conditions (24 trials each).

Prior to presentation, an index card was placed in front of the subject to warn them of the impending trial. The subject was then presented with a consonant triad for 3 seconds, which they were required to repeat aloud. Then the stimulus card was replaced with a blank card and the retention interval/distracter task began (except in the case of the 0 retention interval condition). When it was time to recall the triad the experimenter said the word “recall”. The procedure for each condition is outlined briefly below, (for details and instructions refer to Appendix C.)

1. No distracter - in this condition the subjects were required to read the CCC aloud once (and were specifically told not to repeat the CCC aloud again during the retention interval).
2. Tapping - the subjects tapped with their hand in a circular motion around a pattern of four squares (imposed onto a circle) during the retention interval.
3. In the counting backwards condition, during the retention interval the subject was asked to start counting backwards in threes from a random three digit number (between 101-999) which was spoken by the experimenter.

4. In the articulation condition, the subject was required to repeat aloud the words "one-two" for the duration of the interval.
5. Digit reversal - the experimenter read out a series of two digits (from 1-9) and asked the subjects to reverse them. As each series was reversed the experimenter immediately presented the next pair.

Before each condition commenced the subject was given two trials at the retention interval of 9 seconds so that they understood what was required for the subsequent trials (data from these practice trials were not recorded). Each trial ended when either the subject responded or 15 seconds elapsed. The number of articulations, taps, correct digit reversals and subtractions by threes were recorded during the respective conditions. Recall performance was transformed into the mean percentage of correctly recalled CCC. Correct recall was signified by recall of all the letters making up the trigram (in the correct serial order.) No credit was given to partially correct answers.

2.5 Inspection Time (IT) task

This task involved the correct identification of the longer arm of a briefly illuminated inverted U-shaped stimulus presented on a black "stimulus box". This version of the IT task was designed by Barrett and Eysenck (Electronic Developments (UK) Ltd).

2.5.1 Apparatus

The inverted U display was created by multiple red light-emitting diodes (LEDs) centred on a matt - black panel that formed the front of the stimulus box. The stimulus box was 23 cm in height, 35.5 cm in length and 26 cm wide (see Appendix E for photos of the apparatus.) The image of two vertical "lines of light" (and the cross-bar) were produced by illuminating a series of red bar LEDs. Each multiple segment LED display consisted of 5 LED bars each 30 mm in length and 1 mm in width (the cross-bar consisted of one horizontal LED bar). When 4/5 vertical LEDs were illuminated this gave the impression of a long bar, while on the opposite side of the inverted U 3/5 LEDs were illuminated (the shorter bar) (see Appendix E, Figure E2). Following the stimulus display there was a backward mask where all of the 5 LEDs (on both sides) were illuminated (Appendix E, Figure E3) . At the midpoint between the LEDs where the length difference occurred (in the middle of the 4th LED, 105 mm below the cross-bar) there was a 1 mm circular "fixation point" LED. The stimulus box was connected to a 286 portable IBM compatible NEC computer, which monitored the subjects' performance, initiated the trial events, and calculated the subjects' IT according to version 5 of the BRAT algorithm.

When the task is initiated, the inverted U display is illuminated with one side longer than the other (chosen at random by the computer). Right and left response buttons (connected to the back of the stimulus box) are used by the subject to indicate which line they perceived to be longer. After a varying length of exposure time (timed by the computer and in response to the subject's

performance) there is a backward mask, where all the remaining LEDs not illuminated as part of the stimulus display are now illuminated. All LED illumination is simultaneous. Stimulus timing was discrete, in 2 msec units.

On a typical trial, the fixation point is illuminated and a beep is simultaneously relayed through headphones worn by the subject throughout the task. Then the display is illuminated, which is followed by a backward mask lasting 500 msec then the display is extinguished. Response time and bar of light (left or right) responded to are recorded.

The inter-trial interval was 0.2 seconds. The length of time it takes subjects to complete the task varies, depending on individual performance. However, after 10 minutes has elapsed the computer stops the task and no IT can be assigned.

2.5.2 Procedure

The IT equipment was set up in a dimly lit room, with the IT box adjusted so the fixation light was at eye level for each subject, at a distance of 60 cm. The subject's right and left hands were positioned on the corresponding response buttons (i.e., one response button per hand). The subject could not see the computer screen, which was at a right angle to them, in a position where the experimenter could monitor their progress via the status display.

The subjects were explained the details of the task (refer to Appendix C for details of the instructions) and performed a number of practice trials, until the experimenter was satisfied that they understood what was required and initiated

the session. They were told to respond (using the response buttons) to the line they perceived to be longer. It was emphasised that they could take as much time as they wanted in which to respond. Each subject completed the IT task twice, during separate sessions. The second session is of more interest than the first as the subject by this session has had more experience with the requirements of the task (and *usually* IT is lower). However, the IT score, duration of the task and number of trials completed for both sessions are presented in the Chapter 3.

Chapter 3

Results

Due to the small sample size in each group, only limited statistical analyses have been made. Instead, each subject's performance is presented in the form of a case study, with relevant background information, results from the psychological testing (WAIS-R; WMS-R; NART), and the data from the Brown-Peterson task, release from PI task and the IT task. The main focus was the performance within each subject across the various tests, with comparisons across subjects as appropriate.

This chapter is divided into four main sections: possible AKS patients, alcoholic controls, non alcoholic controls and comparisons across subjects. In the comparison across subjects, three main areas were examined: 1. grouped results of CCC recall in the Brown-Peterson task, plus performance in the four distracter tasks themselves (number of articulations, taps, correct digit reversals and subtractions from threes) to establish whether each subject was performing the distracter tasks at similar rates, 2. grouped performance in the PI task and the number of errors recorded in this task for each subject, and 3. the correlation between IQ scores and IT.

3.1 Possible AKS patients

3.1.1 Case A

3.1.1.1 *Demographics*

Subject A, who was 59.8 years old at assessment, started drinking when he was 14 years old. He is currently undergoing treatment for alcoholism in Nova Lodge, Christchurch (this is his third admission to the centre), where he has resided for a year. According to self report information and details from his file at the treatment centre he has only been considered to have had an alcohol problem for about last 15 years. He had been alcohol free for 1 year prior to this study. He is divorced and has two adult children. He left school when he was 16 and according to his report had only reached form 2, and had previously worked as a farm hand and a landscape gardener.

There was no evidence to suggest that he exhibited any Wernicke's symptoms and there had been no psychological/psychiatric assessment to confirm the diagnosis of AKS although caregivers and medical staff considered this diagnosis possible. While there was limited medical evidence, the staff at Nova Lodge reported that he often had episodes of memory loss, characterised in particular by problems remembering instructions. However, no evidence to suggest remote memory loss had been reported. The staff at Nova Lodge also noted that Subject A's memory loss seem to be more exaggerated each time he returned for treatment. There were no reported CT measures, but no other

evidence of cerebral infarct. At the time of testing he was in good health with no indication of any blood pressure problems.

3.1.1.2 Psychological measures

His FSIQ was 91, verbal IQ 94, and performance IQ was 88 (performance on the individual subtests of the WAIS-R and WMS-R, and associated scaled/weighted scores are presented in Appendix F), which is in the Wechsler's Average range (90-109). The NART predicted a FSIQ of 84, verbal 84 and performance 86, which is slightly lower than his current IQ and falls into the low-average range (80-89). This NART score may be an underestimate, given that measurement error is between 7-10 points; (Knight & Longmore, 1994). For the WMS-R, index scores were generally poor, but not markedly so. His Verbal Memory index was 86, his Visual Memory was 81, his general memory index (GMI) was 82, his delayed memory index (DMI) was 84. His Information/Orientation score was 11. The WMS-R manual cautions that a score below 12 may affect the interpretability of the test as a score lower than this may indicate disorientation, inattention, or dementia. This subject, however, failed to answer correctly the two questions regarding the current and previous USA president, which may reflect a cultural bias as opposed, to some form of deficit. The other question answered incorrectly was the day of the month. During testing he appeared to know where he was and appeared to have no trouble understanding the instructions of the various tasks. Given his Attention/Concentration (98) index which is in the normal range, his WMS-R index scores probably are representative of his memory skills.

Atkinson (1991) has provided information pertinent to WAIS-R/WMS-R differences that indicate relative memory impairment as distinct from any general measurement error. Based on her findings, the difference (9) observed between Subject A's FSIQ and GMI was not significant (the required difference is 15). Furthermore, Bornstein, Chelune and Prifitera (1989) found that IQ and Delayed Memory Index (DMI) discrepancies differentiated a clinical sample (who had a diagnosis likely to be associated with memory impairment) from a "normal" sample, whereas immediate indexes did not. As only 10% of the normal sample reached a 15 point DMI - IQ this difference is suggested as useful cut off point (Atkinson, 1991, suggests 16). However, Bornstein et al. (1989) caution making clinical judgements based on DMI and IQ differences in isolation as only about 30% of the clinical sample (who had diagnoses often associated with memory deficits) had a difference of 15. Subject A's DMI - IQ difference was only 7 points so in the context of relatively normal (if slightly low) IQ, there is again no clear evidence that he has any exaggerated memory deficits relative to his current overall cognitive/intellectual skills. These scores suggest that while considered a possible AKS subject based on anecdotal evidence, Subject A is unlikely to be a "classic" AKS patient, although it should be noted that this inconclusive picture can often be true of even "clinically diagnosed" AKS cases. For example, Jacobson and Lishman (1987) found that eight out of their 38 clinically diagnosed AKS sample were not considered "amnesic". It is noted that Jacobson and Lishman used WAIS-WMS differences; the WMS-R gives substantially lower quotients in AKS patients than the original WMS (Butters et al., 1988) and the

WAIS IQs are generally 7-8 points higher than the IQs established from the WAIS-R (Knight & Longmore, 1994). While the data from Jacobson and Lishman (1987) may not directly comparable, it provides some data with which to compare WAIS-R, WMS-R and NART scores in AKS patients. According to Jacobson and Lishman Subject A would be classed as not amnesic with no IQ decrement.

The apparent lack of any substantial relative IQ - Memory Index differences in Subject A is unlikely to be due to any recent decline in his IQ. According to the NART estimates of pre-morbid IQ there is no evidence of any recent decline in IQ which would otherwise confound any current estimation of possible general memory decline. In fact, his current IQ is better than that estimated from the NART. However, O'Carroll et al. (1993) found that the NART underestimated premorbid IQ (relative to demographic information) in AKS patients by 9 points on average. Therefore this may be why Subject A's NART scores are low.

3.1.1.3 The Brown-Peterson task

Compared to the no distracter condition, where performance was at ceiling (83.33-100%) across all delays, Subject A's performance dropped markedly during the counting backwards in threes, digit reversal and articulation conditions at the 3, 9, and 18 second delays (see Figure 1A, p.49). At the three second delay, performance was equally impaired for these three distracters, but articulation and digit reversal did not further affect recall at longer delays. By contrast forgetting

during the counting backwards task was very poor and reached floor performance at 9 seconds (0% recall) and at the 18 second delay (16.67%) in Subject A. Subject A's performance at all delays during the tapping condition was similar to the ceiling performance of the no distracter condition.

3.1.1.4 Release from PI

Figure 2A (p.52) shows that the mean percentage of words correctly recalled by Subject A was quite low (with an average of <50%), which was surprising given his Verbal Memory Index. Performance was poor even on the first list in each condition (44.44% in the no shift condition and 33.33% in the shift condition.) During the no shift condition the only indication of a build up of PI was that recall dropped from 66.67% in the second list to 33.33% on the 4th list. However, in the shift condition the opposite appeared to happen; in the first list only 3/9 (33.33%) words were correctly recalled, by the 4th list he recalled 6/9 (66.67%) words, and on the shift list (list 5) 6/9 CCC were also recalled, hence there was no evidence or otherwise of any benefit of a category shift in this subject primarily because of improved performance across earlier lists in the "shift" condition.

3.1.1.5 Inspection time

The IT for the first session was quite high (152 msec) indicating that Subject A had trouble performing the task, but by the second session performance

was much better (IT of 72 msec, see Table 1A, p.55). In the second session he took (48 seconds) longer to establish an IT, hence the greater number of trials performed.

The normative sample of 142 people aged 19-55 years (mean 36.89) performed only one session of version 5 of the BRAT algorithm (Barrett, unpublished findings). The mean IT for this normative sample was 79 msec (range 16-466 msec; SD = 74 msec). It should be noted, however, that this normative sample performed only one IT session and it can be expected that their IT would be lower if they had performed a second session. Only 15% of the normative sample had ITs of greater than 120 msec. The subject that scored 466 was a male aged 37 years, the subject that scored an IT of 16 was also a male, aged 43 years. The normative sample is problematic to some degree because subjects were largely younger than the sample used in the present experiment. There were only 5 subjects in the normative sample over 50 years (range 50-55, mean 53 years). The ITs for these older subjects were extracted from this sample to see if there was any evidence of an age related decline in IT, (this “older” sample is of a similar age to the subjects in the present experiment). The mean IT for this “older” group was 128, although one subject’s IT was 390 msec and when this subject was removed from the sample the residual mean was 63 msec (which is actually less than the mean of the entire normative sample). However, as there were only 4 subjects it is difficult to exclude the possibility that there is no aged related decline in IT performance. Also the outlying subject, whose performance

was poor, may be an indicator of performance in some 50+ subjects as opposed to an exception.

Deary et al. (1991) reported that pre-senile Alzheimer patients had a mean IT (single session) of 157.3 msec (SD = 62.9), AKS patients an IT of 96.5 msec (SD = 53.3) and an IT of 93.2 msec (SD 42.9) for the control subjects. Their Alzheimer patients had a mean age of 60.7, the AKS subjects averaged 59.6, and the controls 59.2 years. Comparing these data with those of Barrett's normative sample, it appears that there is probably at best only slight possible age decline in IT as the mean score for control subjects in Deary et al.s' experiment was well within the SD of the mean of the Barrett's sample. Caution, however, is advised in interpreting the differences in the means between those of Barrett and Deary et al, for a number of reasons: 1. there were only 11 control subjects in the Deary et al. (1991) study so there may not be an accurate reflection of the general "aged" population, 2. The IT task used by Deary et al. differs slightly from the present version used and is considered to be a less precise measure of IT.

In comparison to the normative data obtained by Barrett (unpublished findings) Subject A's performance in the first session would be rated in the poorest 15%. In contrast Subject A's performance in the second session was slightly better than the mean of the normative sample (72 msec vs 79 msec). In the first session Subject A performed comparably to the only estimate in the literature for the mean IT of Alzheimer patients (who were tested only for a single session).

3.1.2 Case B

3.1.2.1 *Demographics*

Subject B, is 60.11 years old, and had 2 years of secondary education. He had previously worked as a labourer but was currently unemployed and under the care of Nova Lodge. The manager of Nova Lodge stated Subject B probably started drinking heavily around 35 years ago when he split up with his wife (who has since died). He has children but the exact number is not known, the staff at Nova Lodge suggest that he has at least six. He has had repeated admissions to Nova Lodge since 1984 (Subject B, every year usually has a few months in treatment during the winter). When he is not in treatment it is reported that he is a chronic meths drinker, but he had been alcohol free for 3 months prior to this study. There was little anecdotal evidence regarding remote memory loss, the staff at Nova Lodge report that he now has no trouble remembering the staff when he returns each time for treatment. However, he could not recall the names of regular staff members at a social detoxification centre (Thorpe House) where he had been a regular client of since 1993 (he had been known stay for up to six weeks at a time in Thorpe House).

There is stronger evidence than for Subject A to suggest that Subject B has AKS, although the diagnosis has not been confirmed. Three years ago he had an assessment at Sunnyside Hospital and been “diagnosed” as having severe chronic alcoholism, peripheral neuropathy (which is often associated with AKS; McEntee, Mair & Langlais, 1989; Victor et al., 1989), and possible frontal lobe syndrome

(also consistent with AKS). However, the details of this assessment could not be made available. There was no documented evidence of having undergone a classic Wernicke's phase and no other prior general medical information was available (e.g., no information regarding CT scan) largely due to the mobility of the subject throughout New Zealand. At the time of testing he was in good health with no indication of any blood pressure problems or prior cerebral infarct.

3.1.2.2 Psychological measures

On the basis of the WAIS-R, his FSIQ was 94 (verbal 100, performance 88). His premorbid (NART) IQs were estimated to be slightly higher at 108, 107 and 108 (FSIQ, verbal and performance respectively.) Both his NART scores and IQ scores are in the Average range. By stark contrast, his performance on all WMS-R indexes except the Attention/Concentration index (103) was extremely poor: Verbal Memory 69, Visual Memory 68, GM 58, and his DMI index was 54. His FSIQ-GM difference was 36 (a difference of 15 is indicative of impairment), the FSIQ-Verbal Memory difference was 25, and his FSIQ-Visual Memory difference was 26; all these differences were highly significant (Atkinson, 1991). Bornstein et al. (1989) found that no normal subject had a FSIQ-DMI of more than 28 points, Subject B's FSIQ-DMI was 40 reflecting his severe and selective memory impairment. Subject B scored poorly on Information/Orientation subtest of the WMS-R in which only 9/14 questions were answered correctly. The WMS-R manual suggests that a score as low as 9 may be an indication of dementia, disorientation or inattentiveness. However, his Attention/Concentration index

was in the normal range, he had no difficulty in understanding any instructions and his current IQ was at least average. The five questions he answered incorrectly were his age, the time of day, year, the date and the day of the week, which are notable because they are often characteristic of AKS (Butters & Cermak, 1980). In addition, Subject B often forgot the experimenter's name in their various meetings. However, during the testing he appeared to know where he was and understood the instructions of each experimental task.

However, his NART-FSIQ difference was 14 (standard error range 7-10 points, Knight & Longmore, 1994) indicating a possible decline in IQ functioning. The differences observed in Subject B, according to the classification of IQ and memory deficits (in AKS patients) reported by Jacobson and Lishman (1987), indicated that Subject B fell into the category of Amnesic, with no marked IQ decrement.

Subject B's performance in the psychological measures employed suggest on the basis his WAIS-R - WMS-R discrepancies that he has a severe and relatively selective memory impairment. Performance on these measures and anecdotal information provided indicate that Subject B has cognitive impairments that are consistent with AKS. There may be a slight decline in general cognitive function as established from his NART scores, but his current IQ is still within Wechsler's Average range. Based on this psychological profile and his medical and personal history, it is highly likely that Subject B has AKS.

3.1.2.3 Brown-Peterson performance

Subject B's CCC recall was at ceiling across all delays in the no distracter condition (Figure 1B, p.49). Performance in the digit reversal, tapping and articulation conditions was also at ceiling levels (83.33%-100%) for all delays. In the counting backwards in threes condition recall performance decreased markedly only at 18 seconds. Performance seen here is in sharp contrast to Subject A whose performance dropped to below 60% in three of the five conditions. Unlike Subject A, Subject B's CCC recall was generally extremely good across delays and various distracter conditions, only declining at the most difficult condition (counting backwards at 18 seconds). Subject B's Brown-Peterson performance was all the more remarkable given his generally poor memory skills.

3.1.2.4 Release from PI task

As shown in Figure 2B (p.52), Subject B's general accuracy in the release from PI task was extremely poor. His average recall rate was 40% in the no shift condition and around 40% in the shift, which is lower than that of Subject A. Subject B's recall was variable across lists and during the no shift condition there was no build up of PI with recall only 22.22% accurate at list 1 and only marginally better across the remaining lists (33.33 - 44.44%) Consequently, in the shift condition it is questionable as to whether there was a build up of PI (from list 3 to 4) and if the increase in recall rate at list 5 (33.33% above list 4) is evidence of release.

3.1.2.5 Inspection Time

In the IT task performance by Subject B was very poor (see Table 1B, p.55), even in the second session where IT was 160 msec. With respect to the normative sample (mean = 79 msec) Subject B's IT in both sessions was greater than the 120 msec cut off in which only 15% of "controls" score above. Subject B's IT is comparable to the more impaired Alzheimer patients in Deary et al.s' (1991) study and comparable to many "controls" in the extreme range. While Subject A's IT improved markedly in the second session, Subject B's did not indicating that his performance on this task is poor.

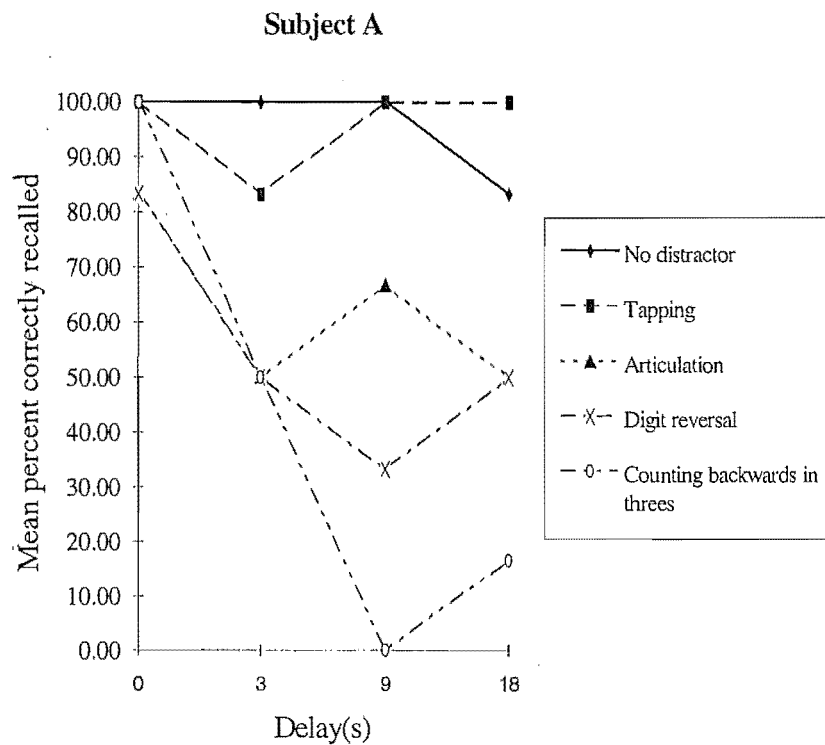


Figure 1A. Mean percentage of correctly recalled CCC for Subject A, in each of the distracter conditions: no distractor, tapping, articulation, digit reversal and counting backwards in threes, across the four delays (0, 3, 9, 18 seconds).

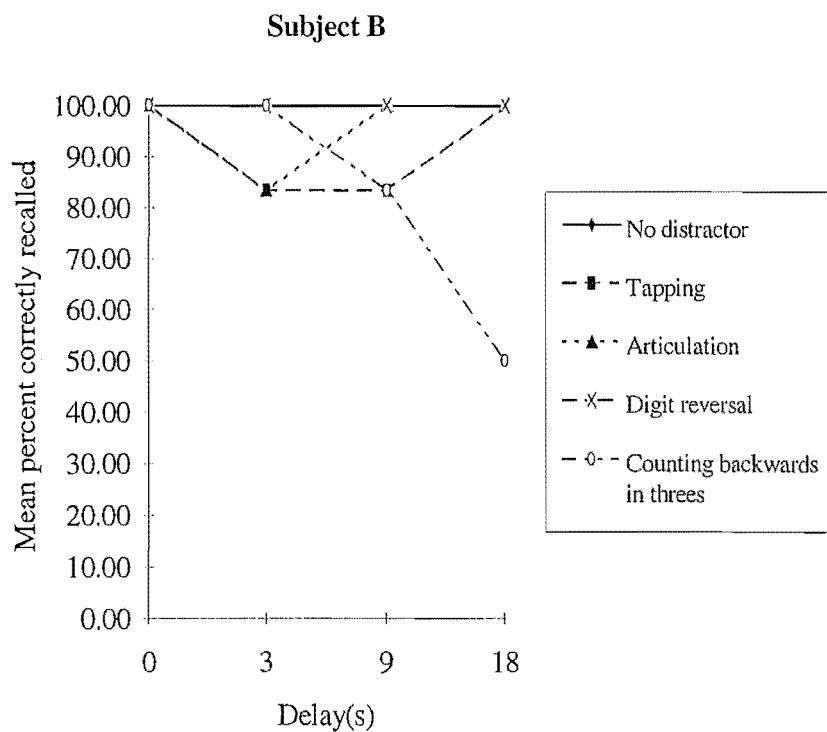


Figure 1B. Mean percentage of correctly recalled CCC for Subject B, in each of the distracter conditions: no distractor, tapping, articulation, digit reversal and counting backwards in threes, across the 4 delays (0, 3, 9, 18 seconds).

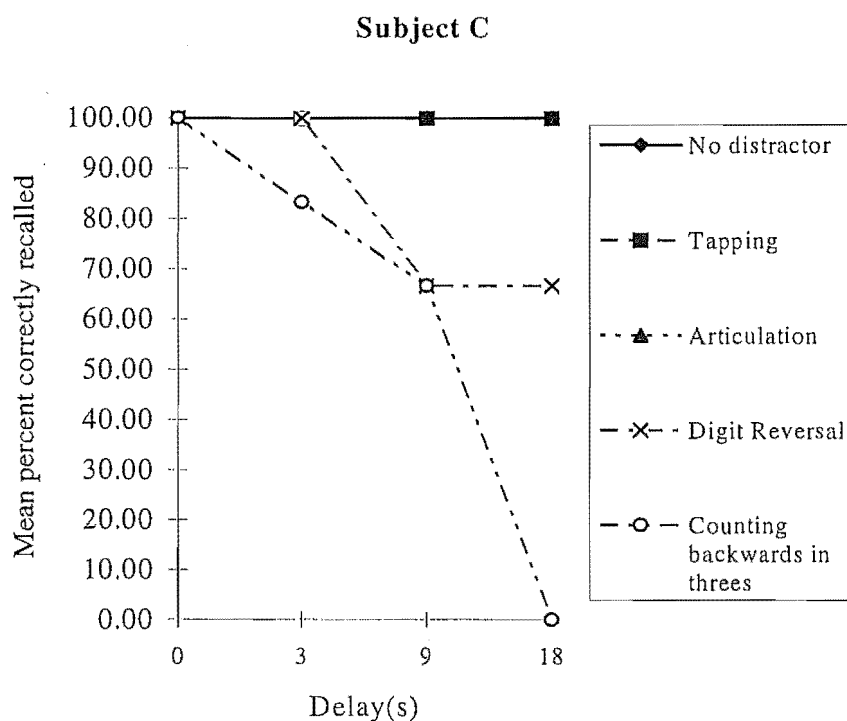


Figure 1C. Mean percentage of correctly recalled CCC by Subject C, in each of the distracter conditions: no distractor, tapping, articulation, digit reversal and counting backwards in threes, at the 0, 3, 9, 18 second delays.

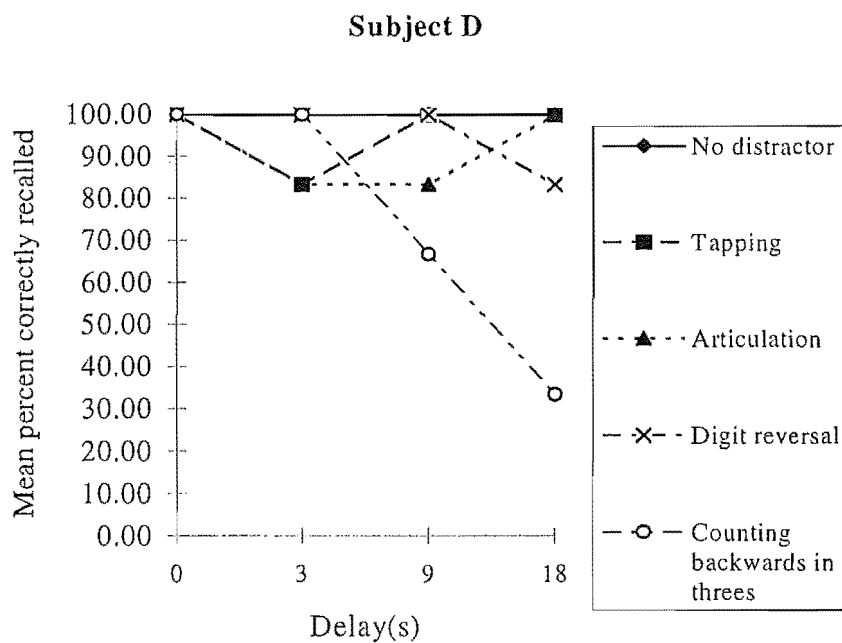


Figure 1D. Mean percentage of correctly recalled CCC by Subject D, in each of the distracter conditions: no distractor, tapping, articulation, digit reversal and counting backwards in threes at 0, 3, 9, and 18 second delays.

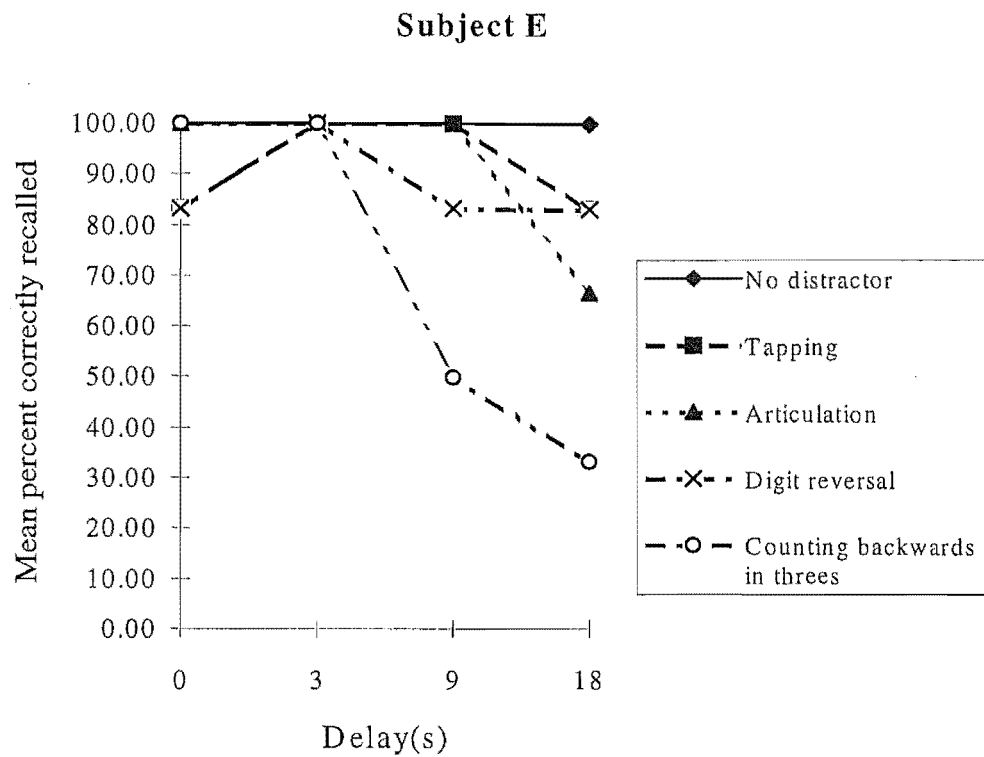


Figure 1E. Mean percentage of correctly recalled CCC by Subject E, in each of the distracter conditions: no distracter, tapping, articulation, digit reversal and counting backwards in threes across the four delays (0, 3, 9, 18 seconds).

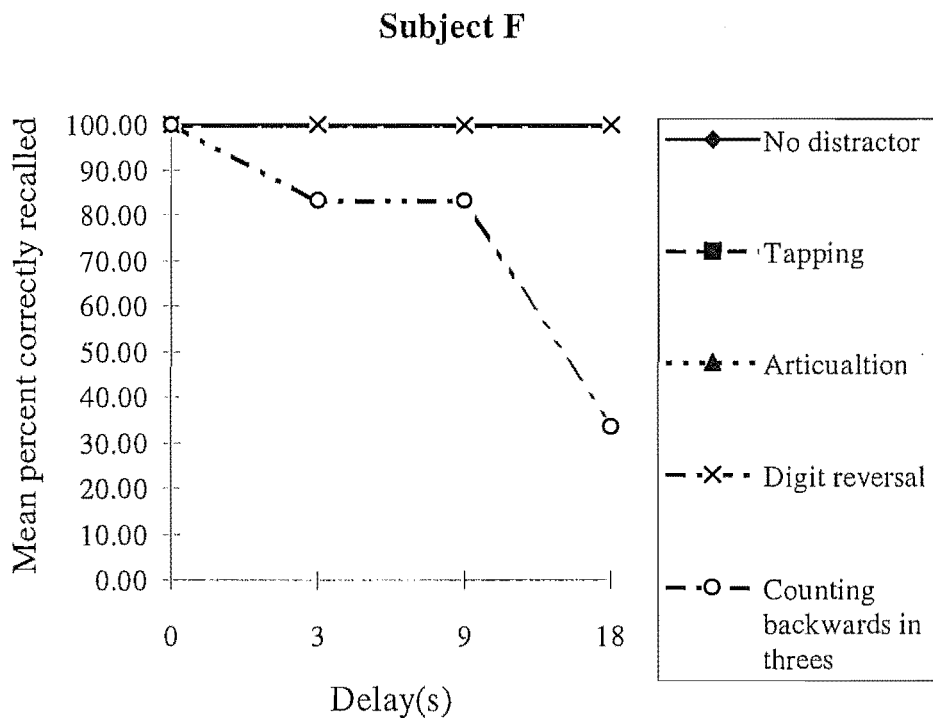


Figure 1F. Mean percentage of correctly recalled CCC by Subject F, at each delay over the five distracter conditions: no distracter, tapping, articulation, digit reversal and counting backwards in threes, across four delays (0, 3, 9, 18 seconds).

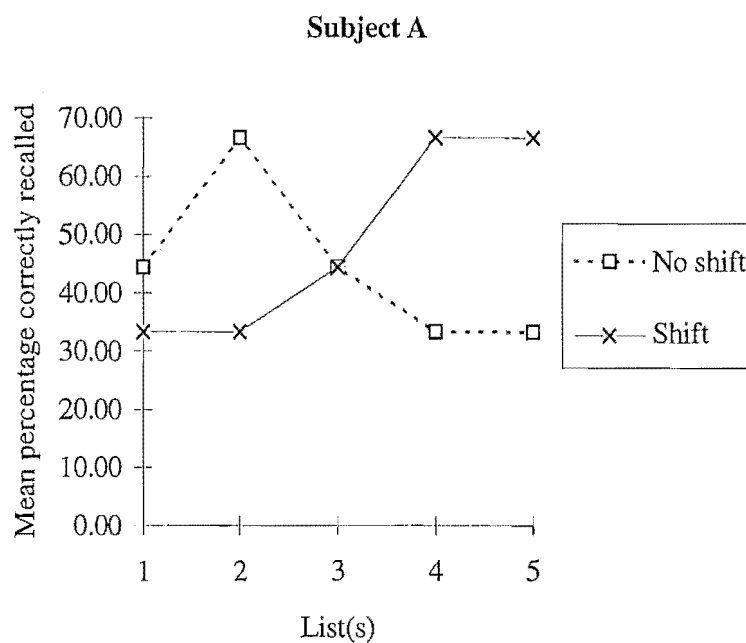


Figure 2A. Mean percentage of correctly recalled words in each list across the shift and no shift conditions, for Subject A.

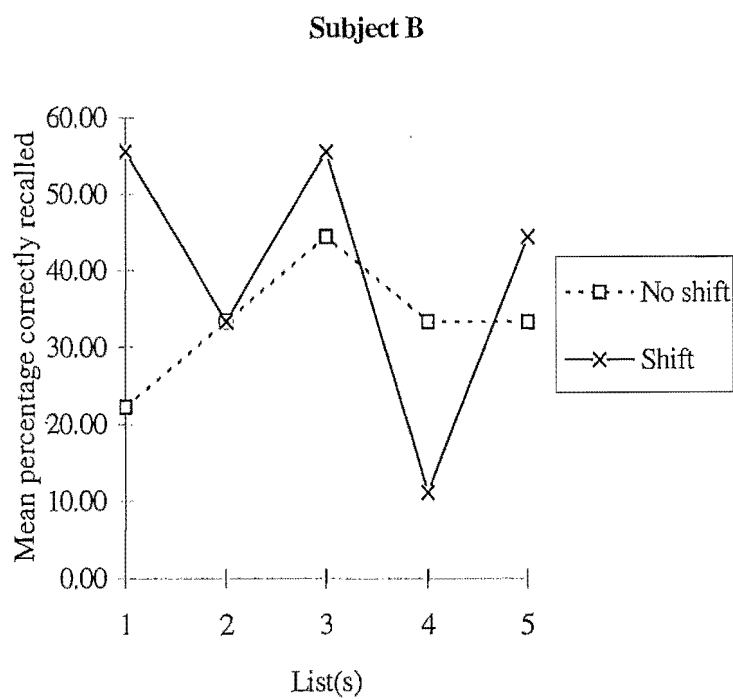


Figure 2B. Mean percentage of correctly recalled words in each list across the shift and no shift conditions, for Subject B.

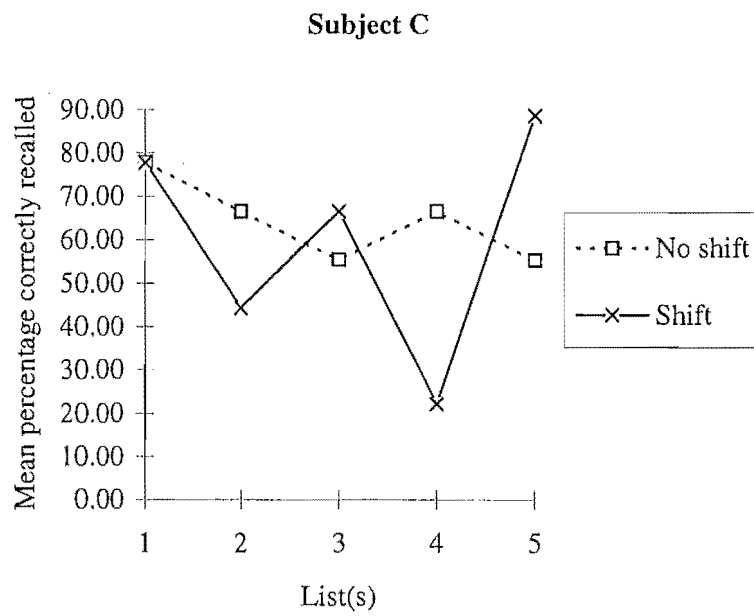


Figure 2C. Mean percentage of correctly recalled words in each list across the shift and no shift conditions, for Subject C.

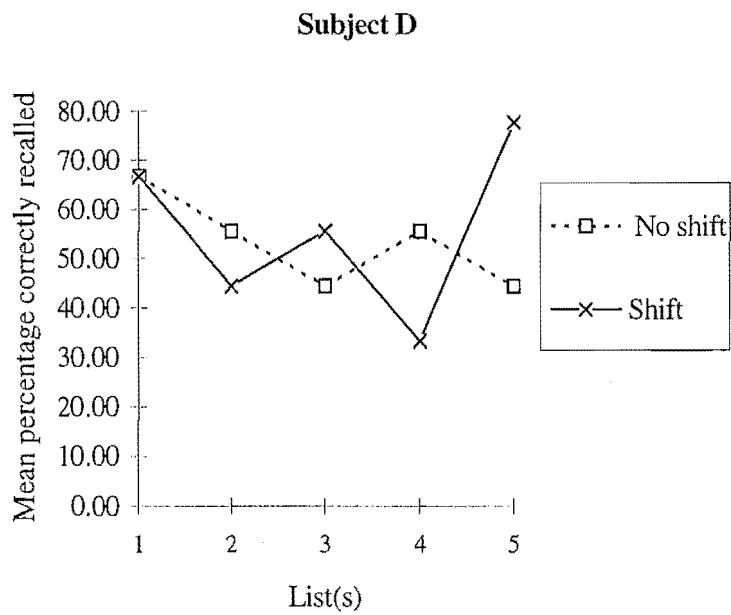


Figure 2D. Mean percentage of correctly recalled words in each list across the shift and no shift conditions, for Subject D.

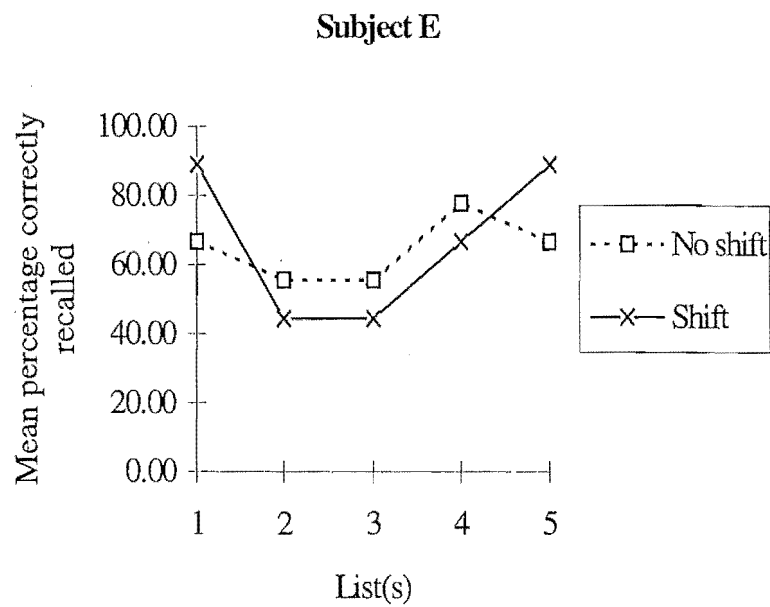


Figure 2E. Mean percentage of correctly recalled words in each of the lists across the shift and no shift conditions, for Subject E.

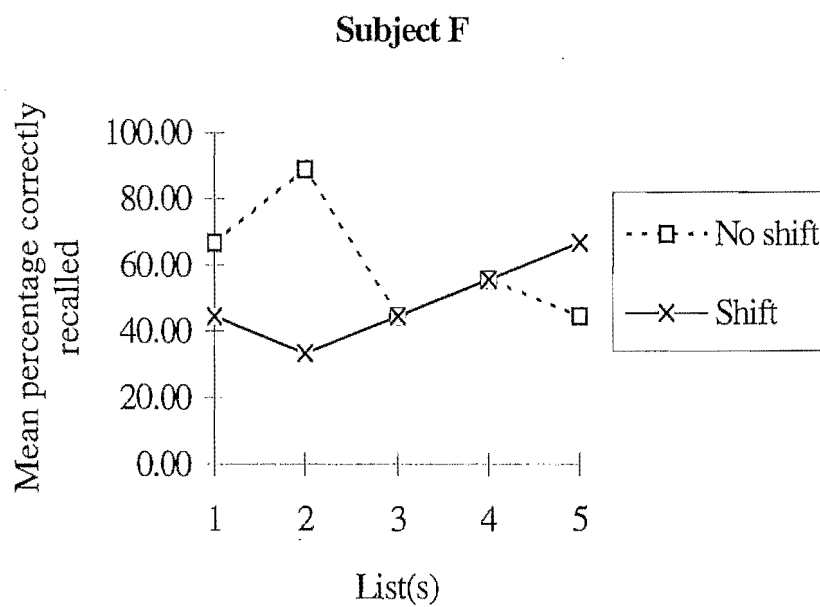


Figure 2F. Mean percentage of correctly recalled words in each list across the shift and no shift conditions, for Subject F.

Table 1A

Inspection Time Recorded in Session 1 and 2, the Number of Trials Performed and the Duration Needed to Establish an IT, for Subject A.

	Session 1	Session 2
Number of trials	119	139
Duration (in minutes)	2.69	3.17
IT (in msec)	152	72

Table 1B

Inspection Time Recorded During Session 1 and 2, the Number of Trials Performed, and the Time it Took to Establish an IT, for Subject B.

	Session 1	Session 2
Number of trials	138	167
Duration (in minutes)	4.08	3.76
IT (in msec)	184	160

Table 1C

Inspection Time Recorded During Session 1 and 2, the Number of Trials Performed, and the Time it Took to Establish an IT, for Subject C.

	Session 1	Session 2
Number of trials	191	145
Duration (in minutes)	4.23	3.27
IT (in msec)	43	32

Table 1D

Inspection Time Recorded During Session 1 and 2, the Number of Trials Performed, and the Duration Needed to Establish an IT, for Subject D.

	Session 1	Session 2
Number of trials	110	143
Duration (in minutes)	2.49	3.26
IT (in msec)	502	324

Table 1E

Inspection Time Recorded During Session 1 and 2, the Number of Trials Performed, and the Time it Took to Establish an IT, for Subject E

	Session 1	Session 2
Number of trials	286	110
Duration (in minutes)	6.45	2.47
IT (in msec)	126	90

Table 1F

Inspection Time Recorded During Session 1 and 2, the Number of Trials Performed, and the Time it Took to Establish an IT, for Subject F

	Session 1	Session 2
Number of trials	112	129
Duration (in minutes)	2.44	2.92
IT (in msec)	90	106

3.2 Alcoholic controls

3.2.1 Case C

3.2.1.1 *Demographics*

Subject C, was 57 years old, and had 2 years secondary education. He is currently employed by Nova Lodge. He first started drinking when he was 15, and had been drinking heavily on a sporadic basis for total of 19 years (with 7 years sobriety interspersed). He had been alcohol free for 4 years at the time of testing, and was in excellent health. His marital status was single. Consistent with his general demeanour and position of responsibility, Subject C gave no indication that he had any overt cognitive or memory problems (e.g., a poor ability to understand instructions) during testing.

3.2.1.2 *Psychological testing*

All his IQ and memory scores demonstrated performance comparable to the average of the (unimpaired) normative sample. His FSIQ was 97 (100 for verbal and 95 for performance). The NART predicted a comparable premorbid IQ of 94, (Verbal 93, and performance 95), all of which are in the Average range. Index scores from the WMS-R were: Verbal Memory 103, Visual Memory 106, GM 104, Attention/Concentration of 99 and DMI of 103; his Information/Orientation score was 13. Thus his memory index scores were average and comparable to his current IQ.

3.2.1.3 Brown-Peterson performance

Subject C performed at ceiling for no distracter and two of the distracter conditions, tapping and articulation (see Figure 1C, p.50). Subject C's performance dropped to 66.67% at the 9 and 18 second delay in the digit reversal condition, and a substantial decrease in CCC recall occurred in the counting backwards in threes condition reaching floor performance at the 18 second delay.

3.2.1.4 Release from PI

Relative to Subjects A and B, Subject C's overall performance (an average of around 60%) was far better across conditions (see Figure 2C, p.53). For Subject C, there was a slight indication of a build up of PI in the no shift condition where performance declined slightly after the first list. In the shift condition there was clearer evidence of a build up of PI (in the 4th list performance was only 22.22%); release from PI was exhibited with accuracy rising to 88.89% on the 5th list.

3.2.1.5 Inspection Time

Table 1C (p.55) shows that Subject C's performance on the IT task was excellent with a IT time in the first session of 43 msec and 32 msec in the second session, which is better than either Subject A or Subject B's (Subject C's IT of 43 msec is 36 msec faster than mean of the normative sample).

3.2.2 Case D

3.2.2.1 Demographics

Subject D, is aged 53.3 years, had been drinking since he was 18 years old, but only had a recognised problem for about the last 13 years. He was undergoing treatment in Nova Lodge and had been alcohol free for 2 1/2 months at the time of testing. There is confusion over his number years of education; he claims to have left school at age 18 years, yet never attended high school. This may be possible if he had been held back, but it seems unlikely that someone would stay at intermediate school until they were 18. However, like Subject A it is assumed that he had no secondary education. He is in good health. His marital status is single. Subject D gave no indication that he had any cognitive or memory problems (e.g., problems understanding instructions) during testing.

3.2.2.2 Psychological measures

Subject D's FSIQ was 85, verbal 89, and performance 89. These scores are in the Low - Average range. His NART performance indicated a full scale IQ of 94, verbal 94, and performance 97, which is slightly more than his current IQ and would be classified as average, (but compared to current IQ is within the standard error range of 7-10). All his WMS-R index scores were above his current IQ (Verbal 96, Visual 92, GM 93, Attention/Concentration 105, DMI 93, and the Information/Orientation score was 14.)

3.2.2.3 Brown-Peterson performance

There were virtually no errors in recall for Subject D in the no distracter and tapping conditions (see Figure 1D, p.50). In the articulation and digit reversal conditions Subject D's recall was also at ceiling. In the counting backwards task, however, recall declined to 66.67% and 33.33% respectively for the 9 and 18 second delays.

3.2.2.4 Release from PI

Subject D's overall recall performance was above 50% across conditions, which on average is higher than that made by Subjects A and B (see Figure 2D, p.53). There was some evidence of a build up of PI in the no shift condition (performance in the first list was 66.67% declining to 44.44% by the fifth) and in the shift condition (66.67% recalled on the first list to 33.33% at the fourth). Release from PI was demonstrated in the shift condition as at list 5 the recall rate increased from list 4 by 44.37% (to 77.78%).

3.2.2.5 Inspection Time

Surprisingly, Subject D performed extremely poorly on the IT task, even in the second trial where his IT was 324 msec (see Table 1D, p.56). It is unlikely that this is due to an inability to maintain attention as the task only took 3.26 minutes to complete (in the second session). If Subject D had a problem in maintaining concentration it would be expected the duration of the

task to take longer (indicating that the subject was not producing consistent results.) His performance related to the normative sample is greater than 120 msec so is considered to be in the poorest performing 15%. He even performed extremely poorly relative to Deary et al.s' Alzheimer patients!

3.3 Non-alcoholic controls

3.3.1 Case E,

3.3.1.1 Demographics

Subject E is 55.4 years old. He is married and has 3 adult children. He had 2 years secondary education and is employed as a carpenter/joiner. There was no evidence to suggest any general cognitive impairment or current/past history of alcohol abuse.

3.3.1.2 Psychological measures

All his scores on the WAIS-R and the corresponding NART scores (in brackets) were in the average range and are as follows: FSIQ 101 (104), verbal 94 (102) and performance 111 (105). In the WMS-R his Information/Orientation score was 14, GM was 92, Attention/Concentration 91, and his DMI was 93. He performed surprisingly poorly on the logical memory subtest of the WMS-R and subsequently his Verbal Memory Index was only 80 (compared with a Visual Memory Index of 114, which is more consistent with his IQ functioning). His FSIQ-Verbal Memory difference was 21 indicating a

significant memory decrement on this subtest (Atkinson, 1991). The poor verbal memory performance may partly be due to the fact that testing was only possible at night after a full day of work and fatigue may have played a factor. However, he had a DMI - FSIQ difference of 7, which is less than the difference of 15 points suggested by Bornstein et al. (1989) as a useful cut off point. Bornstein et al. (1989) suggest that the DMI - FSIQ difference is a more reliable indicator of a genuine memory decrement than the differences between IQ and immediate indexes (such as the Verbal Memory Index).

3.3.1.3 Brown-Peterson performance

Subject E's recall of CCC was at ceiling in the no distracter condition, tapping and digit reversal across delays. In the articulation condition performance dropped to 66.67% at the longest delay (see Figure 1E, p.51) In the counting backwards task performance declined to 50% and 33.33% respectively at the 9 and 18 second delays.

3.3.1.4 Release from PI

Accuracy for Subject E was on average greater than 60% across conditions (see Figure 2E, p.54). Subject E's performance in both conditions did not consistently decline from list 1-4/5, and therefore Subject E failed to demonstrate any clear evidence of PI build up in either condition.

3.3.1.5 Inspection Time

Table 1E (p.56) shows that in the first session Subject E appeared to struggle with the task, he completed 286 trials and his IT was 126 msec (only 15% of the normative sample scored above 120 msec). However, performance in the second IT session was a lot more consistent (with fewer trials and a shorter duration) and the IT score was 90 msec. Subject E's performance was in between the ITs recorded for Alzheimer patients and control/AKS patients in Deary et al.s' experiment.

3.3.2 Case F

3.3.2.1 Demographics

Subject F is 58.5 years old and had 3 years of secondary education. He is currently employed for Southpower and is involved in the development of contracts, although he had originally trained to be an electrician. He is married with four adult children. There was no evidence to suggest any general cognitive impairment or current/past history of alcohol abuse.

3.3.2.2 Psychological measures

His FSIQ was 108, (verbal 103, performance 113). His performance IQ was in the High-Average range. His NART scores were FSIQ 100, verbal 99, and performance 100. Subject F's Verbal Memory index was 103, Verbal 138, GM 115, Attention/ Concentration 99, DMI 120, and his Information/

Orientation score was 13. All of the WMS-R scores were either above or the same as the WAIS-R scores except for the attention/concentration index, which was 99.

3.3.2.3 Brown-Peterson performance

In the Brown-Peterson task performance over the no distracter and the first 3 distracter conditions was at ceiling (see Figure 1F, p.51). In the counting backwards in threes condition performance was maintained at 83.33% at the 3 and 9 second delays but a clear decrease in performance was seen at the 18 second delay where only 3/9 CCC were recalled correctly.

3.3.2.4 Release from PI

Subject F's average recall rate was about 60% in the no shift condition and about 50% in the shift. Similar to Subjects B and E in the release from PI task there was no clear evidence of PI in Subject F. In the shift condition (see Figure 2F, p.54), performance generally increased as the number of lists increased. In the no shift condition there was some indication of a build up of PI, with performance declining after the first two lists.

3.3.2.5 Inspection Time

In the first IT session, Subject F, had an IT of 90 msec which is comparable to the controls in the Deary et al. study and to the mean of Barrett's

normative sample. In the second session performance increased to 106 msec (see Table 1F, p.56). The duration and number of trials for the experiment were quite low, indicating consistent performance in both sessions. It would be usual to expect that the IT score in the second session would be lower, but the actual difference between the two sessions was very small.

3.4 Comparisons across subjects

3.4.1 Brown-Peterson

A clear trend arose from the data in the Brown-Peterson task when pooled across subjects. While there was a degree of individual variation in this task, all subjects showed a relative decrease in performance at the 9 and especially at the 18 second delay in the counting backwards in threes distracter condition (see Figure 3, p.70). There was also a degree of variable performance in other distracter conditions across delays. The subjects were pooled together as one group to look at the overall performance at the 3, 9, and 18 second delays in the four distracter conditions (the no distracter condition was excluded as there was almost no variance in performance; this was also the case for the 0 delay).

A repeated measures ANOVA revealed a main effect for delay ($F(3,15) = 13.66, p < .001$) and post-hoc comparisons confirmed significant decrements in recall at the 9 second ($F(3,15) = 6.25, p < .01$), and 18 second delays ($F(3,15) = 29.54, p < .001$). There was also a main effect for distracter condition ($F(2,10) = 8.63, p < .01$).

The interaction between delay and condition was also significant $F(6,30) = 11.68, p < .001$. Simple main effects revealed that only the counting backwards showed a significant delay effect ($F(2,10) = 19.94, p < .001$). There was some indication that digit reversal may interfere with recall, $F(2,10) = 3.08, p < .10$; perhaps with a larger sample this may have been significant). Further analyses revealed that there were significant differences in recall between the tapping condition and the counting backwards in threes condition at the 9 and 18 second delays ($F(1,5) = 7.66, p < .05$; $F(1,5) = 76.23, p < .001$, respectively); the articulation condition and counting backwards condition (at the 9 and 18 second delays, $F(1,5) = 15.0, p < .02$; $F(1,5) = 31.96, p < .01$). Performance in the digit reversal condition was also significantly higher than the counting backwards performance at the 9 and 18 second delays ($F(1,5) = 16.0, p < .02$; $F(1,5) = 106.14, p < .001$.)

Subject A (refer to Figure 1A, p.49), in comparison to the groups' results, performed more poorly in three of the conditions, counting backwards, digit reversal and articulation. Subject B, D, and E's performance was comparable to the group means. Subject C's performance in the counting backwards task at 18 seconds was worse than the group, and in the digit reversal performance was slightly less than that of the group (approximately 70% performance vs the group mean of 80%). Subject F's recall rate was the best in the group, dropping only at the longest delay in the counting backwards condition.

3.4.2 Performance in the Distracter Tasks

The mean number of correct digit reversals and subtractions from threes, and the number of taps and articulations recorded per second for each subject are presented in Table 2 (p.71). Morris (1986) found that at the longest delay (20 seconds) in the more demanding distracter conditions all subjects were slowing down their rate of distracter task performance. Repeated measures ANOVAs in the present study revealed no significant differences in any distracter performance measure across any of the delays. Inspection of the individual data also confirms this finding and show that performance for each distraction measure across subjects were generally similar and unrelated to CCC recall performance.

3.4.3 Release from PI - Grouped data

The variability in the release from PI tests was surprising in that only Subjects C and D showed a definitive build up of PI, and release in the shift condition. It may be that the individual differences overshadowed the overall effects taking place. The data from each subject in this task was grouped to see if there was any overall effect for conditions taking place (see Figure 2, p.70).

In both the shift and no shift conditions there appeared to be an overall slight build up of PI for the group. In the shift condition there was also evidence of release from PI; performance increased from 42.59% in the 4th list to 72.22% on the 5th list. A repeated measures ANOVA revealed no main

effects for condition or list. However, there was an interaction between condition and list $F(4, 20) = 5.41, p < .005$. A post hoc comparison revealed that recall ability in list 5 of the shift condition was significantly better ($F(1,5) = 48.99, p < .001$) than the 5th list in the no shift condition.

3.4.4 Errors recorded in the PI task.

The errors in this task were either, a) intralist intrusion errors, where a word from a previous list was recalled on a subsequent list, or b) an extralist intrusion error- the subject in this case recalled a word from the same category but not from a previous list.

Overall there were more intralist intrusions than extralist errors (see Table 3, p.72). The differences between the conditions (shift and no shift) were minimal (a maximum of two in any subject). Performance across subjects was variable, for example Subject A had no errors while Subject B had 6 intralist intrusions and 3 extralist intrusions. Although intralist intrusions are reported as characteristic of AKS subjects (Butters, 1985), Subject B made no more of these than did one alcoholic control and one non-alcoholic control.

3.4.5 Inspection Time

The ITs obtained in the first session were correlated with IQ across subjects. The correlation was $-0.72, df = 4, p = 0.104$. The second session IT score is considered to be a more accurate estimate of IT so the second IT scores

were also correlated with current IQ. The correlation coefficient was $-.60$ $p = .207$. The correlation values were if anything higher than expected, although neither was significant but this is presumably due to the small sample size (lack of statistical power).

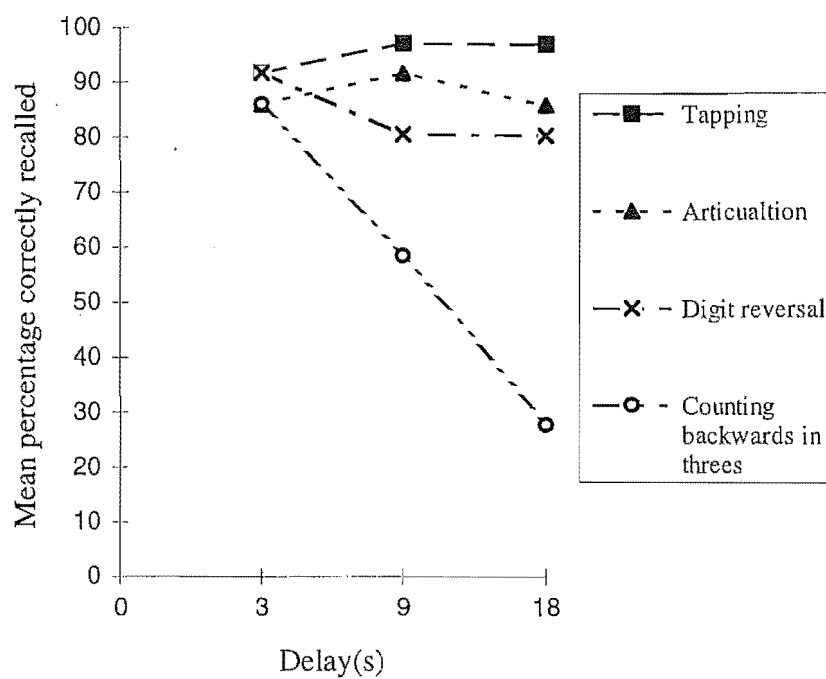


Figure 3. Mean percentage of correctly recalled CCC for **all** subjects at the 3, 9 and 18 second delay across four distracter conditions.

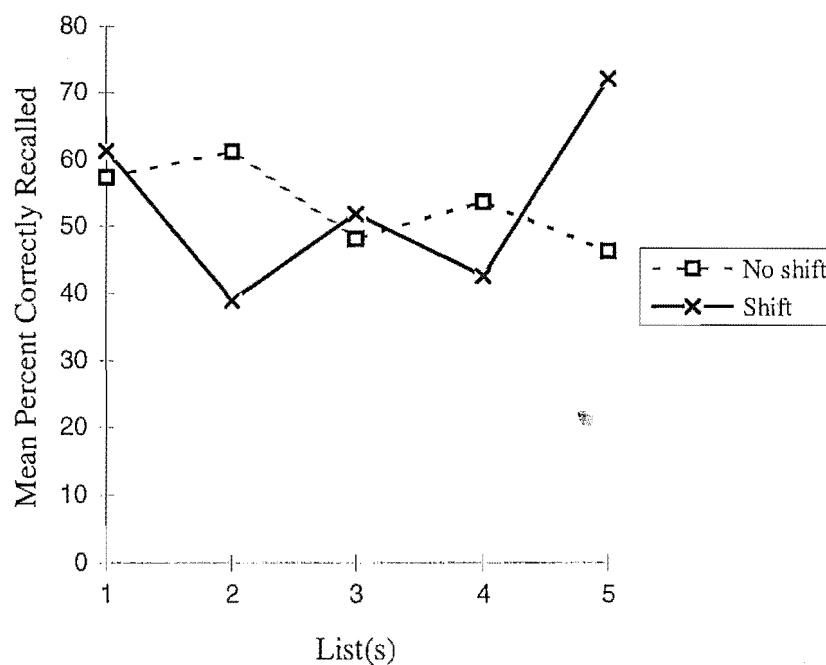


Figure 4. Results from the proactive interference task, for **all** subjects, showing the mean percentage of words correctly recalled across five lists in the shift and no shift conditions.

Table 2

Mean Rate of Taps, Articulations, Correct Digit Reversals and Subtractions in Threes Per Second, in the Brown-Peterson Task for Each of the Subjects at 3, 9, and 18 Second Delays.

Delays	Mean number of taps			Mean number of articulations			Mean number of correct digit reversals			Mean number of correct subtractions in threes		
	3	9	18	3	9	18	3	9	18	3	9	18
Subject A	2.39	1.94	2.11	1.11	1.02	1	0.33	0.33	0.31	0.28	0.26	0.32
Subject B	1.76	1.83	2.04	1.56	1.44	1.58	0.33	0.33	0.30	0.39	0.31	0.29
Subject C	2.33	2.46	2.46	1	0.94	0.94	0.33	0.33	0.35	0.28	1.5	0.45
Subject D	1.83	1.86	2.03	1.33	1.37	1.23	0.5	0.39	0.35	0.28	0.24	0.20
Subject E	3.56	3.41	3.56	1.67	1.74	1.66	0.33	0.35	0.41	0.33	0.22	0.21
Subject F	1.83	1.69	0.61	1.22	1.11	1.06	0.39	0.43	0.42	0.33	0.31	0.25

Table 3

The Number of Intralist and Extralist Intrusion Errors made by each Subject in the Release from PI Task, in the Two Conditions (Shift and No Shift).

Subject	Intralist Intrusion Error(s)		Extralist Intrusion Error(s)	
	Shift	No Shift	Shift	No Shift
A	0	0	0	0
B	4	2	1	2
C	0	2	0	0
D	4	2	2	0
E	2	4	0	0
F	1	3	2	0
Totals	11	13	5	2

Chapter 4

Discussion

4.1 Possible AKS patients

Prior to this study the clinical status of Subject A and B as possible AKS patients had not been established. However, Harper et al. (1986) found that 80% of the AKS cases diagnosed at necropsy had not received a diagnosis of AKS during their lifetime. Both Subject A and B had a history of chronic alcoholism and anecdotal evidence suggested that they may have memory impairments, and on this basis they were selected for the present study. Neither subject had medical evidence to suggest that they had gone through a Wernicke's phase, but a history of WE or symptoms related to WE are often not present in AKS patients (Martin et al., 1986; Blansjaar & van Dijk, 1992). For this reason, evidence of a Wernicke's phase was not a requirement in this study, although Subject B had documented evidence of peripheral neuropathy which often co-exists with WE or AKS (Knight & Longmore, 1994).

Subject A's diagnosis as an AKS patient is highly unlikely in light of his performance on standard psychological measures, which indicated that his general memory skills were not particularly poor nor disproportionate relative to his

current or premorbid intellectual function. The performance of Subject A in the Brown-Peterson task, however, indicated that even the articulation distracter task, which takes little effort to perform, was demanding enough to interfere with his recall. The more demanding distracters, such as digit reversal and counting backwards in threes, considerably impaired his ability to recall the CCC. In addition, his recall performance was quite low overall in the release from PI experiment. These experimental tasks suggest a degree of cognitive impairment in Subject A that is similar to that often found in AKS patients. Overall, one can tentatively conclude that Subject A has a mild degree of cognitive dysfunction, but it is important to acknowledge that this picture may simply reflect a moderately low level of cognitive functioning (memory and intellectual) already present in this individual.

By contrast Subject B's performance on the psychological measures suggested strongly that he is an AKS patient, that is with "normal" IQ functioning but with grossly impaired memory function (i.e., a 40 point difference between his DMI - FSIQ; 36 point difference in FSIQ - GM; around 25 point difference between his Verbal/Visual Memory Indexes - FSIQ). Subject B also showed some evidence for a disorientation in time (in the Information/Orientation subtest of the WMS-R) and difficulties in remembering people's names, which are characteristic of AKS (Cermak & Butters, 1980). However, while Subject B performed poorly on the release from PI task he did surprisingly well on the Brown-Peterson task. As pointed out in Chapter 1, it is generally concluded that poor Brown-Peterson performance is characteristic of AKS patients (Butters, 1985; Longmore &

Knight, 1988); but some researchers, notably Kopelman (1985, 1991), have found unimpaired Brown-Peterson in a majority of their patients. Subject B's performance provides additional evidence that a Brown-Peterson task impairment requires a different neuropathological profile to that which can produce severe memory impairments on the WMS-R.

Anecdotal evidence which may be useful in aiding with a diagnosis is often limited in the extent and nature of the information it can provide. In the present study it was particularly difficult to establish the extent of any possible remote (retrograde) memory impairments in Subject's A and B, although it appeared unlikely that any major problems existed in this regard. It is proposed that future work would benefit from a more structured approach for examining retrograde amnesia and that it should take advantage of a psychometric instrument such as the Otago Remote Memory Test (Psychology Department, Otago University) which asks 70 multi-choice questions on famous New Zealand people. In addition, particularly useful tests that would improve our knowledge of the cognitive profile of potential AKS subjects are: hypothesis testing (problem solving) using the WCST, and semantic memory as tested by verbal fluency and the retention of definitions, because these tests are regarded as sensitive to impairments in AKS (Butters, 1985). The addition of such tests would be especially informative of Subject A's diagnostic status and help confirm the impression that he is an alcoholic with cognitive dysfunction.

4.2 The Brown Peterson task performance

Subject A performed poorly in the Brown-Peterson task compared to Subject B and the control subjects (both the alcoholic and non alcoholic controls). Subject A's performance in the articulation condition was similar to the SDAT patients in Morris' (1986) study (performance dropped to as low as 50% for the SDAT patients and for Subject A). The SDAT patients' performance, however, in the digit reversal condition dropped to 10% recall (at the longest delay-20 seconds) while Subject A's greatest decrement was 40% correct recall at (9 seconds) in the same condition. Unlike the SDAT patients whose performance in the tapping condition dropped to less than 60% at the longest delay, Subject A's performance only dropped slightly here. Performance in the Brown-Peterson task for Subject B, the alcoholic controls and the non alcoholic controls, was similar to (and in some cases higher than) Morris' elderly controls in the no distracter, tapping, articulation and digit reversal conditions.

As Morris' study did not include a counting backwards in threes condition, comparisons are made here with the performance of AKS patients, Alcoholic Dementia patients and alcoholic controls in the study by Longmore and Knight (1988), who used the same "classic" distracter condition as employed in the present study (counting backwards in threes from a random three digit number). Subject A's performance was similar to the AKS and Alcoholic Dementia patients in this condition (whose mean recall performance was about 10% correct at the longest delay). The performance in the counting backwards condition in this task for Subject B, D, E and F was comparable (although performance was slightly

lower for Subject D) to the alcoholic controls (non-alcoholic controls were not included in the sample) in the Longmore and Knight study. Subject C on the other hand performed at a level similar to their AKS patients.

4.2.1 Brown-Peterson performance in the present study and the relationship to Baddeley's model of working memory

The most demanding condition, counting backwards in threes at the 18 second delay produced a significant impairment in recall across subjects. Baddeley's (1992) model of working memory predicts that when the load on working memory (and the CES) is high (in the more demanding distracter conditions) the capacity of the CES may be exceeded and therefore recall will decline. The present study suggests that even "normal" subjects' processing resources often fail to cope with successful recall of CCC when performing the distracter task in the most demanding condition, whereas less demanding distracters have little or no effect.

In case of Subject A, whose performance was markedly impaired compared to the other subjects, even the articulation distracter condition, which is assumed to use a relatively small amount of processing resources, abnormally interfered with recall of the CCC. This evidence suggests that Subject A, similar to the SDAT patients in Morris' study, may have a faulty central executive ("dysexecutive syndrome") and may not possess sufficient processing resources to cope with a dual task situation even when the task is relatively easy to perform.

4.2.2 *Tentative conclusions from the Brown Peterson task*

The present study highlights the fact that demanding distracter tasks can interfere with recall. This may in part explain why studies on Brown-Peterson performance in AKS have failed to show a consistent impairment, as the distracter task often employed has been less demanding than the usual counting backwards in threes distracter, (e.g., Baddeley & Warrington, 1970) and this may be less sensitive in detecting impairments in AKS patients.

However, in contrast to what was predicted Subject A (not obviously AKS) but not Subject B (probable AKS) was impaired in the Brown-Peterson task. Thus a CES impairment may not be a general characteristic of AKS. CES impairment may be present in some alcoholics who have a degree of cognitive impairment, and perhaps in the many AKS patients who have additional cognitive impairment beyond the classic amnesic syndrome.

4.2.3 *“Dysexecutive syndrome”: Evidence for frontal lobe dysfunction?*

If intact frontal lobe functioning is required for the CES (as suggested by Norman & Shallice, 1980) then performance on the Brown-Peterson may vary according to the degree of alcohol related frontal lobe damage in AKS patients and alcoholic controls (Leng & Parkin, 1989). Kopelman (1985), however, suggests that short-term memory impairments such as poor performance on the Brown-Peterson task may result from the general effects of chronic alcohol abuse rather than AKS lesions per se.

The different view proposed by (Kopelman, 1985, 1991b) is that Brown-Peterson deficits may be related to atrophy throughout the left and right hemisphere rather than specifically the frontal lobes. Similarly, Morris (1994) proposed that more widespread damage, rather than frontal damage, may be responsible for CES deficits. Kopelman (1985) found that the two AKS patients in his experiment who performed poorly on the Brown-Peterson had only a moderate degree of cerebral atrophy and suggested that additional factors such as neurotransmitter disturbances may be required for impaired Brown-Peterson performance to occur. The data reported here from Subjects A and B could perhaps be explained in this way, although one must be extremely cautious when comparing the results of a few case studies (Kopelman, 1985). Subject A who is unlikely to be AKS performed was severely impaired even with “mild” distracters on the Brown-Peterson, while Subject B’s performance was comparable to the controls. One might tentatively predict then that MRI scans may reveal more cortical atrophy in Subject A than in Subject B even though only the latter is probably an AKS patient.

4.3 Release from PI

Performance for Subjects A and B suggested that there was only limited build up of PI in one of the two conditions (for Subject A it was in the no shift condition and Subject B showed limited PI build up in the shift condition). Overall their recall performance was low. This failure to demonstrate clearly a build up of PI has been found previously in some studies with AKS patients (e.g.,

Longmore & Knight, 1988). In the present study the alcoholic controls' recall rate was in general higher than the AKS patients and both non-AKS alcoholic subjects showed evidence of a build up of PI in the no shift condition and in the shift condition where release was exhibited, in a similar fashion to Longmore and Knight's alcoholic controls who also released from PI. Interestingly, the non alcoholic controls who were expected to exhibit a mild build up (and release) of PI did not clearly do so as performance tended to increase in these subjects as the number of lists increased. AKS patients are sensitive to interference effects and characteristically show more intralist intrusions (Butters, 1985); Subject A had none of these errors (despite poor performance) while Subject B had 6, yet this was no more than two of the control subjects (one alcoholic control and a non alcoholic control).

These variable results across subjects suggest that the release from PI performance is predominantly a group effect, with individuals often not showing the "classic" effect. Also the poor performance makes it difficult to make any comparisons between performance on the Brown-Peterson and release from PI in this case, and whether the underlying processes in these tasks are related (in particular, frontal lobe function).

Failure to release from PI in AKS patients has also been linked with possible frontal lobe dysfunction in this patient group (Squire, 1982). In the present study, the main problem with the PI task was that recall was generally too poor on the first lists, minimising any possibility of a subsequent drop in performance over the remaining lists, thus the PI data of the present study do not

provide any clear indication of potential frontal lobe problems in Subject A or B. To reiterate an earlier point, it is advisable that future research includes additional tasks sensitive to frontal lobe impairment, such as verbal fluency and the WCST (especially the number perseverations made on these tests; Butters, 1985), to specify more clearly any presence or otherwise of any functional frontal lobe impairments.

4.4 Inspection Time

Subjects' performance in the IT task exhibited a large variance which restricts considerably the strength of any conclusions that can be made based on performance in this task. For example, Subject B performed poorly overall, Subject D's performance was extremely poor and Subject C performed extremely well (36 msec faster in the first session than the mean of the normative sample).

There are no data to indicate whether there is an age-related decline in IT performance. The data from 4/5 subjects aged 50-55 in the normative sample suggest there is no age-related decline in this cohort, but there are as yet insufficient data to say whether performance in these subjects are representative of the general population. The ITs of elderly control subjects in Deary et al.s' (1991) study are broadly comparable to Barrett's normative sample despite the differences in the IT algorithms employed. Taking performance in the first session only, Subjects A, B and D performed comparably with Deary et al.s' Alzheimer patients (who performed significantly poorer than Deary et al.s' AKS patients). Thus the current data imply that alcoholics in general may in fact be

impaired on the IT task, but considerable additional work including more normative data is required to test this possibility.

As Barrett's normative sample (and Deary et al.s' subjects) only completed one IT session, the comparative performance of the second session in the present experiment to a "normal" sample cannot be made, as it is not established how much IT may improve in the second session. Data from the present study indicate that any change in performance is variable. For example, Subject A performed (in relation to the normative sample) relatively poorly on the first session, but in the second session his IT was slightly lower than the mean of the normative sample's IT (an improvement of 80 msec). Subject F's IT on the other hand marginally increased in the second session (by 16 msec). The current data suggest that previous studies using only one session in which to establish an IT may not reflect the "true" IT of the subjects and therefore the conclusions based on these earlier results may be misleading.

As some subjects in the normative sample performed poorly on the IT task it is difficult to explain what might be happening in the present individuals and whether the performance for Subject B and D is related to alcohol abuse (and possible brain damage) or not. The poor IT performance of Subjects B and D, however, suggest that both subjects have a sustained attention deficit.

Although not significant (probably due to the sample size and lack of statistical power) the IQ-IT relationship for the first session was -0.72. The correlation between IT and IQ in the second session was -0.6, which is similar to previous studies (Deary & Egan, 1991, reported an average of -0.5) which support

the expectation that higher IQ is associated with better is performance on the IT task.

4.5 Possible attention deficits related to alcohol abuse

The following tentative conclusions are suggested regarding possible attentional deficits in subjects with a history of alcohol abuse. Subject B's relatively good Brown-Peterson performance but poor IT indicates that a global attentional deficit may not be present in this probable AKS patient. His performance dependent on CES was unimpaired, whereas his performance in the sustained attention task was relatively poor suggesting a possible problem in the latter only. Subject A's performance in the Brown-Peterson was poor, while his IT was "normal", which provides additional evidence to support a possible dissociation between sustained and divided attention in alcoholic subjects. However, Subject C (alcoholic control) performed extremely well in the IT task and relatively well in the Brown-Peterson suggesting that long-term alcohol abuse does not necessary lead to any impairments in either attention category.

4.6 Limitations of the present research and some suggestions for future research

The limitation of the present study is the number of subjects and the relative poverty of medical and other (e.g., personal) evidence pertinent to the confirmation or otherwise of a clinical diagnosis of AKS for Subjects A and B. While additional tests are recommended (see section 4.1) the present study has provided strong psychometric evidence to suggest that Subject B has AKS, whereas a diagnosis of AKS for Subject A is unlikely and warrants extreme caution. However, it would appear that Subject B may have a degree of alcohol related cognitive impairment as his performance on some tasks was poor (in comparison to Subject B and the control subjects).

Due to the limited sample it is difficult to know what variation in individual and group performance may be related to alcohol abuse or may be due to individual differences in performance, especially as the performance across the experimental tasks was so varied. This may reflect that the underlying processes involved in the Brown-Peterson and release from PI are not the same. However, the variability within the each subject and across subjects render this conclusion a cautious one at best.

Subject E was a non-alcoholic control who performed relatively well in the experimental task yet his performance on the WMS-R indicated that his Verbal Index was significantly impaired. Highlighting the point that “normals” often can perform at cognitive levels that are considered to significantly different

from the normal population and reflect some form of impairment, Knight (1983) found that over 25% of the normative sample (aged 16-17 years) exceeded the significant difference between verbal IQ and performance IQ (in a reliability study of the WAIS-R). The point here is that, like AKS subjects, controls to have widely varying skills and this fact needs to be acknowledged, even when large sample sizes in group designs provide the statistical power to affirm significant group differences.

4.6.1 *Location of potential AKS subjects in Canterbury*

The inability to locate “clinically diagnosed AKS patients” in the present study may reflect the status of New Zealand’s AKS population. The introduction of the Privacy Act (1993) and the subsequent Health Information Privacy Code (1994) have made feasibility studies to access the number of potential AKS subjects very difficult. In particular, no health related information (e.g., names and locations of AKS patients) can be given out unless ethical approval has been granted (from a Regional Health Authority Ethics Committee), and then only if the agency (involved in the care of AKS patients) agrees. In the present study the presence of AKS patients could not be assessed until ethical approval was granted, such approval was required by health carers before records could be checked, yet at one point ethical approval was dependent on knowing if any subjects existed.

Even after approval had been granted, in my experience many agencies were unwilling to disclose such information despite being made aware of the

provision in the Health Information Privacy Code (1994). This reflects the confusion created by the Privacy Act (1993) over what can be disclosed and what can not. Hopefully once agencies become more familiar with the Act this information will be disclosed more readily. With Health restructuring in New Zealand a lot of once institutionalised AKS patients are now in the community and no longer under some form of formal care, making them almost impossible to locate. While this is the current status in the Canterbury region, it seems unlikely that finding AKS patients anywhere else will be easier, as these issues are standard policy for health agencies. Although it may be that in other areas of New Zealand there is some form of formal care specifically for AKS patients, this is something that future researchers would need to establish before embarking on any grouped-based experimental research in this area.

4.6.2 Potential pharmacotherapy for AKS patients

There currently is no treatment available for AKS patients, who are seen as having irreversible cognitive impairments and thus medical resources are not devoted to treatment for such patients. The purpose of this section is to point out that not only is the cognitive status of “AKS” subjects quite variable, so too is their neuropathology, and it is quite possible that this variability may be the cause for optimism for potential drug treatments.

It has been well documented that the location and extent of brain damage associated with AKS is variable (e.g., Victor et al. 1989; Butters, 1985; Kopelman, 1995). It is accepted that damage to parts the diencephalon results in

memory impairment, but the degree of cortical atrophy (in particular the frontal lobes) and associated cognitive deficits is somewhat more questionable (Knight & Longmore, 1994). In addition to this a number of researchers have reported that important NE sites and pathways are lesioned in AKS (Victor et al. 1989; McEntee & Mair, 1978, 1983) but it appears that this may be additional damage that is not seen in all AKS patients (Halliday et al., 1992). Martin and Weingartner et al. (1984) attempted to replicate the deficient NE metabolite findings of McEntee and Mair (1983) but found no significant differences in CSF NE metabolite concentrations between AKS patients and controls. In Weingartner et al.s' study the experimental population showed greater variability in CSF metabolite concentrations compared to controls, a finding that strengthens the notion that damage to NE pathways may be "additional" in some patients.

McEntee and Mair's clonidine studies have reported found that performance on the Brown-Peterson task could be significantly improved with the administration of clonidine (an agonist in NE-depleted subjects). More recent work by O'Carroll, Moffoot, Ebmeier, Murray and Goodwin (1993) attempted to replicate the findings based on McEntee and Mair's (1980) protocol. Using the same neuropsychological measures, design and clonidine dosage, they found no significant improvement (over placebo) on any of the cognitive measures employed, including the Brown-Peterson task. The small procedural differences between the studies is an unlikely explanation for the discrepant findings. The authors suggest that the differences may be due to the age range of the subjects used in the different studies, and/or chronicity of the amnesic symptoms of the

subjects. The above findings of variable evidence of NE depletion in AKS subjects (and variable damage to NE sites) may explain why clonidine failed to produce a reliable improvement in O'Carroll et al.s' study. Arnsten and Goldman-Rakic (1985) found that their oldest monkey (which presumably had greatest NE decline, due to catecholamine loss with age) showed the greatest memory improvement with administration of clonidine. Research such as this implies that only the AKS patients with most deficient levels of NE will show an improvement when treated with clonidine. Arnsten and Goldman-Rakic (1985) suggest that clonidine can improve working memory performance through actions at the postsynaptic alpha-2 receptors in the principal sulcal region of the prefrontal cortex (which has been implicated in attention and AKS). If clonidine improves working memory tasks in NE-deficient individuals, then the Brown-Peterson with varying load on the distracters as used in the present study should provide a sensitive test of the drugs utility.

At the onset of this study, the intention had been to test the idea that clonidine might improve attentional deficits in AKS patients particularly in the context of the Brown-Peterson task. Given the pattern of data presented in this study it would be especially interesting to see if clonidine alleviated impaired episodic memory in patients such as Subject B (who had no Brown-Peterson deficit) or whether clonidine's benefits are restricted only to those alcoholic subjects who have CES and related attentional deficits.

It would also be of interest for future research to establish whether clonidine affects the release from PI task. If the underlying mechanisms of the

two tasks (release from PI and Brown-Peterson) are the same, it can be assumed that clonidine should improve performance on the tasks in a similar manner. While McEntee and Mair (1980) and Mair and McEntee (1986) have shown that Brown-Peterson performance of AKS subjects is improved by clonidine, no evidence is available with respect to the release from proactive interference effect.

4.7 Conclusions

The results from the pilot work presented here suggest that performance across different attention tasks is variable and may reflect varying brain damage or dysfunction as a result of alcohol abuse. One probable AKS subject with poor WMS-R performance was unimpaired on the Brown-Peterson task, whereas a second subject, who was originally suspected as a possible AKS patient but does not have clear deficits in the WMS-R, performed poorly on the Brown-Peterson task. The present study provides tentative evidence that cognitively impaired alcoholic patients may have difficulty with the IT task. Both sustained and divided attention have been linked to the frontal lobes (Parasuraman & Haxby, 1993), but there is a lack of understanding of the frontal lobe function and its role in cognitive processes (Oscar-Berman, 1984). It may be that frontal lobe damage is necessary for the “dysexecutive syndrome” and this may vary according to the degree of frontal lobe damage as a result of alcohol abuse, (but see Morris, 1994). It is suggested that one way to establish whether the underlying mechanisms involved in cognitive tasks such as the Brown-Peterson and release from PI task

are similar is with the administration of clonidine, which in previous studies has been shown to improve Brown-Peterson performance, in some AKS patients.

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Appendices

Appendix A

Information and consent forms for the AKS patients and their caregivers and for the control subjects (note the same forms were used for the alcoholic controls and the non alcoholic controls).

University of Canterbury

Department of Psychology

You are invited to participate as a subject in a research project studying memory performance in people with Korsakoff's Syndrome. The main aim of this research is to study performance on some memory tasks and place such findings in a theoretical framework that may benefit future research.

You will be required to undergo some general tests to obtain measures of problem solving ability and general memory performance, complete some specific memory tests, and provide some personal information (e.g., age etc.). The testing procedure will take about six hours of your time (in several separate sessions.)

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation. The identity of

participants will not be made public and individual data will not be released unless you and your relative/caregiver gives specific written consent. To ensure anonymity and confidentiality each subject will be given a number and referred to only by that number throughout the study. No names will be linked to the results in any way.

The project is being carried out by Sarah Goodson, who can be contacted at (03) 343-3434 (home) or (03) 366-7001 extn 7196 (university). She will be pleased to discuss any concerns you may have about participation in the project. You may also contact her supervisor, Dr John Dalrymple-Alford, on (03) 366-7001, extn 7998 or extn 7174. If you have any queries or concerns regarding your rights as a participant in this research, you may wish to contact the Patient Advocacy Service, telephone (03) 364-0581.

This project is supported by the Department of Psychology, University of Canterbury, and the Health Research Council. It has gained ethical approval from the Canterbury University Human Ethics Committee, and the Southern Regional Health Authority Ethics Committee (Canterbury).

I hope you will take part. Your interest will add to the scientific knowledge of Korsakoff's Syndrome.

CONSENT FORM.

PROJECT TITLE: Working Memory and Attention in Patients with Korsakoff's Syndrome.

RESEARCHER: Sarah Goodson Ph (03) 366-7001 extn 7196

SUPERVISOR: Dr John Dalrymple-Alford Ph (03) 366-7001 extn 7998
or extn 7174

I have read and understood the description of the above-named project. On this basis I agree to participate as a subject in the project, and I consent to the publication of the results of the project with the understanding that anonymity will be preserved. I understand that I can withdraw from the project at any time, including the withdrawal of any information I have provided, without penalty of any kind.

I consent to my GP being contacted by the researchers to obtain relevant medical information from him/her.

I have discussed the research with Sarah Goodson and I am aware that I may ask questions at any time throughout the study and that I am free to call either the researcher or supervisor (as listed above) if I have any questions or queries. If I have any queries or concerns regarding my rights as a participant in this research, I can contact the Patient Advocacy Service, telephone (03) 364-0581.

I am aware that this research project has been granted ethical approval from the University of Canterbury Ethics Committee and the Southern Regional Health Authority Ethics Committee (Canterbury).

SIGNATURE: _____ DATE: _____

WITNESS: _____

SIGNATURE OF RESEARCHER: _____

University of Canterbury

Department of Psychology

Your relative/patient is invited to participate as a subject in a research project studying memory performance in people with Korsakoff's Syndrome. The main aim of this research is to study performance on some memory tasks and place such findings in a theoretical framework that may benefit future research.

Each subject will be required to undergo some general tests to obtain measures of problem solving ability and general memory performance, complete some specific memory tests, and provide some personal information (e.g., age etc.). The testing procedure will take about six hours of their time (in several separate sessions).

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation. The identity of participants will not be made public and individual data will not be released unless the subject and their relative/caregiver gives their specific written consent. To ensure anonymity and confidentiality each subject will be given a number and referred to only by that number throughout the study. No names will be linked to the results in any way.

The project is being carried out by Sarah Goodson, who can be contacted at (03) 343-3434 (home) or (03) 366-7001 extn 7196 (university). She will be pleased to discuss any concerns you may have about participation in the project. You may also contact her supervisor, Dr John Dalrymple-Alford, on (03) 366-

7001, extn 7998 or extn 7174. If you have any queries or concerns regarding your relative's/patient's rights as a participant in this research, you may wish to contact the Patient Advocacy Service, telephone (03) 364-0581.

This project is supported by the Department of Psychology, University of Canterbury and the Health Research Council. It has gained ethical approval from the Canterbury University Human Ethics Committee, and the Southern Regional Health Authority Ethics Committee (Canterbury).

I hope you will consent to you relative/patient taking part in this study. Your interest will add to the scientific knowledge Korsakoff's Syndrome.

CONSENT FORM.

PROJECT TITLE: Working Memory and Attention in Patients with Korsakoff's Syndrome.

RESEARCHER: Sarah Goodson Ph (03) 366-7001 extn 7196

SUPERVISOR: Dr John Dalrymple-Alford Ph (03) 366-7001 extn 7998
or extn 7174

I have read and understood the description of the above-named project. On this basis I give my consent for my relative/patient under my care to participate as a subject in the project, and I consent to the publication of the results of the project with the understanding that anonymity will be preserved. I understand that I can withdraw my consent at any time from the project, including the withdrawal of any information I have provided, without penalty of any kind.

I agree to my relative/patient's GP being contacted by the researchers to obtain relevant medical information from him/her.

I have discussed the research with Sarah Goodson and I am aware that I may ask questions at any time throughout the study and that I am free to call the either the researcher or supervisor (as listed above) if I have any questions or queries. If I have any queries or concerns regarding the rights of my relative/patient as a participant in this research, I can contact the Patient Advocacy Service, telephone (03) 364-0581.

I am aware that this research project has been granted ethical approval from the University of Canterbury Ethics Committee and the Southern Regional Health Authority Ethics Committee (Canterbury).

SIGNATURE: _____

DATE: _____

WITNESS:

SIGNATURE OF RESEARCHER:

University of Canterbury
Department of Psychology

You are invited to participate as a control subject in a research project studying memory performance in people with Korsakoff's Syndrome. The main aim of this research is to study performance on some memory tasks and place such findings in a theoretical framework that may benefit future research.

You will be required to undergo some general tests to obtain measures of problem solving ability and general memory performance, complete some specific memory tests, and provide some personal information (i.e. age etc.). The testing procedure will take about six hours of your time (in several separate sessions.)

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation. The identity of participants will not be made public and individual data will not be released unless you give your specific written consent. To ensure anonymity and confidentiality each control subject will be given a number and referred to only by that number throughout the study. No names will be linked to the results in any way.

The project is being carried out under the direction of Sarah Goodson, who can be contacted at (03) 343-3434 (home) or (03) 366-7001 extn 7196 (university). She will be pleased to discuss any concerns you may have about participation in the project. You may also contact her supervisor, Dr John Dalrymple-Alford, on (03) 366-7001, extn 7998 or extn 7174. If you have any

queries or concerns regarding your rights as a participant in this research, you may wish to contact the Patient Advocacy Service, telephone (03) 364-0581.

This project is being supported by the Department of Psychology, University of Canterbury, and the Health Research Council. And has also gained ethical approval from the Canterbury University Human Ethics Committee, and the Southern Regional Health Authority Ethics Committee (Canterbury).

I hope you will take part. Your interest will help us add to the scientific knowledge Korsakoff's Syndrome.

CONSENT FORM.

PROJECT TITLE: Working Memory and Attention in Patients with Korsakoff's Syndrome.

RESEARCHER: Sarah Goodson Ph (03) 366-7001 extn 7196

SUPERVISOR: Dr John Dalrymple-Alford Ph (03) 366-7001 extn 7998
or extn 7174

I have read and understood the description of the above-named project. On this basis I agree to participate as a control subject in the project, and I consent to the publication of the results of the project with the understanding that anonymity will be preserved. I understand that I can withdraw from the project at anytime, including the withdrawal of any information I have provided without penalty of any kind.

I have discussed the research with Sarah Goodson and I am aware that I may ask questions at any time throughout the study and are free to call either the researcher or supervisor (as listed above) if I have any questions or queries. If I have any queries or concerns regarding my rights as a participant in this research, I can contact the Patient Advocacy Service, telephone (03) 364-0581.

I am aware that this research project has been granted ethical approval from the University of Canterbury Ethics Committee and the Southern Regional Health Authority Ethics Committee (Canterbury).

SIGNATURE:_____DATE:_____

WITNESS:_____

SIGNATURE OF RESEARCHER:_____

Appendix B

A list of the words used in the release from PI task, from each of the three categories; animals, occupations and countries.

In the no shift condition the following words from the category animals were presented in the following order:

List 1	List 2	List 3	List 4	List 5
Camel	Elephant	Rabbit	Cat	Deer
Octopus	Bat	Ant	Rhino	Cattle
Hyena	Squirrel	Mule	Lamb	Hen
Chicken	Duck	Owl	Goose	Pony
Bird	Goat	Wolf	Parrot	Boar
Calf	Seal	Mouse	Hog	Gorilla
Snake	Hare	Pigeon	Horse	Rat
Pig	Dog	Sheep	Tiger	Lion
Fox	Cow	Bear	Monkey	Whale

In the shift condition the first four lists contained words from the category of occupations. The fifth list had a list of nine countries.

List 1	List 2	List 3	List 4	List 5
Maid	Consultant	Typist	Professor	Argentina
Foreman	Gardener	Musician	Architect	Russia
Miner	Cleaner	Butcher	Editor	Spain
Undertaker	Actor	Hairdresser	Surgeon	Greece
Dentist	Banker	Painter	Photographer	Egypt
Attorney	Carpenter	Fisherman	Caterer	Kuwait
Policeman	Soldier	Nurse	Courier	Switzerland
Teacher	Shopkeeper	Biologist	Builder	Korea
Porter	Lecturer	Artist	Secretary	Jamaica

Appendix C

Appendix C contains a detail description of all the instructions the subjects received in each of the experimental tasks.

Release from PI

The following instructions were read to each subject at the onset of each session:

"I will show you a list of familiar words, one at a time. Read each one aloud and try to remember them."

After the 9 words had been shown, the subject was immediately asked to recall as many words as they could remember. Then there was a 10 second break followed by the next set of instructions:

"I will show you some more familiar words one at a time. Read each one aloud and try to remember them."

Then the second list (from the same category) was presented in the same manner as described above. In subsequent trials the same instructions were repeated as required.

Brown-Peterson paradigm

During the practice trials and the experimental trials the following instructions were given in each of the conditions. During subsequent trials the instructions were shortened if the subject understood what was required.

1. No distracter:

"I am going to show you three letters. Read each one aloud and try to remember them. After a varying amount of time I will ask you to recall the three letters I showed you. Please do not continue to repeat the letters out loud during this time."

2. Tapping:

"I am going to show you three letters. Read each one aloud and try to remember them. Straight after, I will say the word, "tap", then you should begin to tap your hand on these squares (the experimenter pointed to the card with squares on it and demonstrated what the subject had to do), until I ask you to recall the three letters you saw earlier."

3. Counting backwards in threes:

"I am going to show you three letters, read each one aloud and try to remember them. I will then say a three digit number, which you should start counting backwards from in 3's. For example, if I say 300, you would start counting backwards like this: "297, 294, 291, 288", until I ask you to recall the three letters. Do you understand?"

4. Articulation:

"I am going to show you three letters. Read each one aloud and try to remember them. Then I will ask you to repeat the words, "one-two", over and over like this: "one-two, one-two, one two" until I ask you to recall the three letters."

The experimenter reminded the subject to repeat the words "one-two" when the retention interval began until the experimenter said "recall".

5. Digit Reversal:

"I am going to show you three letters. Read each one aloud and try to remember them. I will then read out 2 digits one after another. When I do this, please reverse the pair, right after I say it. For example, I may say 2-3, you would say?"

If the subject responded by saying, "3-2", then the practice trials began.

The digit pairs were read at a rate of one pair per second. The digits used in conditions 2 and 4 were obtained from the tables of random numbers in the Eton tables book.

IT instructions:

The following instructions were presented (based on the methodology of Barrett & Eysneck, personal communication):

"This task will measure how much time you need in order to tell the difference between a long and short bar of light. The long bar will sometimes be on the left and sometimes on the right side. Whichever side you think is longer, press the button which matches that side. For example, if the longer bar is on the right side press the button in your right hand, if the left is longer, press the button in your left hand. For each trial you will hear a beep from the headphones, and a little light will illuminate here (experimenter points to the fixation point on the stimulus box). Focus on this light. After a short interval, the two lines will be illuminated. You should press the button which indicates the longer of the two lines. We are not measuring the time you take to respond - take as long as you want."

The subject was then given a series of practice trials starting at 510 msec duration, with the longer bar on the right. The experimenter then stated *"As you can see, the right line was longer. Note that both lines get longer after a little while, then the whole display went off."* The subject was then given several

practice trials varying the position of the longer bar (left or right) with feedback from the experimenter until they understood what was required. The subject was then told *"When we begin you will be given several trials one after another, in the same way as the practice was. They will start off easy and will get more difficult as you proceed. It will get to a point where you will not be able to tell the difference between the two lines of light. At that point, don't worry, just guess. After a while the task will get easier and you will be able to tell the difference again. Here is an example of how fast the presentation can be."* The experimenter then programmed the computer to show the display at 2 msec. *"As you can see that was impossible to tell the difference between the two lines, in this case just guess. Don't worry, the display will definitely get slower again."*

"Please try as best you can to concentrate during this task. The experiment does not go on for more than 10 minutes - it is usually less. It may seem like a long time but in reality it is very short. Remember, you don't need to look at your watch or to speak. This task needs all your attention. Remember to respond on the same side as the longer line."

Appendix D

No Distractor

- | | |
|--------|---------|
| 1. ZXF | 6. BQZ |
| 2. QGJ | 7. ZGN |
| 3. KFQ | 8. QXF |
| 4. CQZ | 9. ZWQ |
| 5. GKX | 10. XQF |
| | 11. QLJ |
| | 12. ZQS |

Tapping

- | | |
|---------|---------|
| 1. ZFQ | 13. ZQH |
| 2. JXQ | 14. HXF |
| 3. HXJ | 15. QXJ |
| 4. KHQ | 16. ZXD |
| 5. GCQ | 17. GXZ |
| 6. FPW | 18. ZXC |
| 7. ZXK | 19. ZCK |
| 8. MQJ | 20. HXQ |
| 9. ZDW | 21. ZQX |
| 10. XKH | 22. BQJ |
| 11. QFZ | 23. ZTX |
| 12. XQH | 24. JQH |

Counting Backwards

- | | |
|---------|---------|
| 1. KQM | 13. XQD |
| 2. XMZ | 14. ZJQ |
| 3. XFH | 15. QGZ |
| 4. ZJH | 16. XZF |
| 5. QZH | 17. ZJT |
| 6. ZSQ | 18. QJS |
| 7. XZJ | 19. DQH |
| 8. ZWJ | 20. XZC |
| 9. QHJ | 21. ZFJ |
| 10. CQJ | 22. XGC |
| 11. FQH | 23. ZQW |
| 12. ZXJ | 24. KXH |

No Distractor

- | | |
|--------|---------|
| 1. QZJ | 7. HJX |
| 2. TZH | 8. FWQ |
| 3. XFJ | 9. ZHX |
| 4. GJX | 10. XGZ |
| 5. CQJ | 11. QGC |
| 6. QGW | 12. ZQB |

Articulation

- | | |
|---------|---------|
| 1. ZTK | 13. GQK |
| 2. FQC | 14. ZJX |
| 3. ZTF | 15. XZD |
| 4. QWJ | 16. GQH |
| 5. ZSJ | 17. ZQJ |
| 6. XBQ | 18. KWG |
| 7. XGQ | 19. ZHW |
| 8. ZXH | 20. CGQ |
| 9. XJQ | 21. ZGF |
| 10. ZXG | 22. FQW |
| 11. FQJ | 23. XHJ |
| 12. XQJ | 24. ZHJ |

Digit Reversal

- | | |
|---------|---------|
| 1. XQF | 13. ZHK |
| 2. HXB | 14. XQL |
| 3. ZMX | 15. QSJ |
| 4. KXQ | 16. XBN |
| 5. XFQ | 17. QXH |
| 6. XQG | 18. XZQ |
| 7. JQZ | 19. XGK |
| 8. XKQ | 20. KXZ |
| 9. ZQC | 21. XSZ |
| 10. QKB | 22. SZJ |
| 11. KQX | 23. XFZ |
| 12. GQZ | 24. CQK |

Appendix E

The following figures are a series of photographs of the Inspection Time task equipment and demonstrations of the task while it is running. Unfortunately the quality of the photos is poor and they are slightly distorted. However, they give some idea of the setup of the equipment and what the inverted U display actually looks like when the task is running.

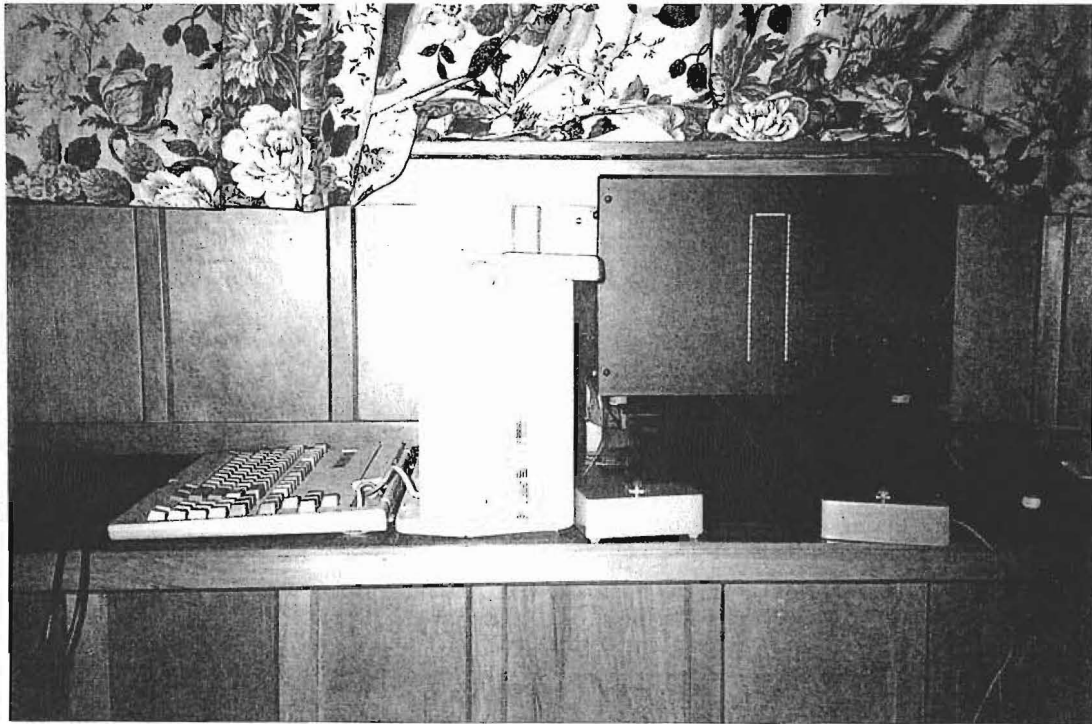


Figure E1. The IT apparatus: the NEC computer, stimulus box and right and left response buttons.



Figure E2. The IT stimulus box and display while the experiment is running, indicating that the right side of the inverted U display is longer.



Figure E3. The IT stimulus box when the inverted U display is completely lit, demonstrating the backward mask.

Appendix F

Table F1

WAIS-R Scaled Scores for Subject A.

Verbal Subtests	Scaled Scores	Performance Subtests	Scaled Scores
Information	8	Picture Comprehension	7
Digit Span	6	Picture Arrangement	6
Vocabulary	10	Block Design	7
Arithmetic	8	Object Assembly	6
Comprehension	11	Digit Symbol	4
Similarities	8		
Total	51	Total	30

Table F2

WAIS-R Scaled Scores for Subject B.

Verbal Subtests	Scaled Scores	Performance Subtests	Scaled Scores
Information	10	Picture Comprehension	6
Digit Span	8	Picture Arrangement	4
Vocabulary	12	Block Design	8
Arithmetic	8	Object Assembly	8
Comprehension	9	Digit Symbol	4
Similarities	10		
Total	57	Total	30

Table F3*WAIS-R Scaled Scores for Subject C.*

Verbal Subtests	Scaled Scores	Performance Subtests	Scaled Scores
Information	7	Picture Comprehension	7
Digit Span	9	Picture Arrangement	6
Vocabulary	11	Block Design	8
Arithmetic	13	Object Assembly	7
Comprehension	9	Digit Symbol	7
Similarities	8		
Total	57	Total	35

Table F4*WAIS-R Scaled Scores for Subject D.*

Verbal Subtests	Scaled Scores	Performance Subtests	Scaled Scores
Information	7	Picture Comprehension	9
Digit Span	10	Picture Arrangement	7
Vocabulary	6	Block Design	5
Arithmetic	6	Object Assembly	3
Comprehension	8	Digit Symbol	5
Similarities	9		
Total	46	Total	29

Table F5*WAIS-R Scaled Scores for Subject E.*

Verbal Subtests	Scaled Scores	Performance Subtests	Scaled Scores
Information	10	Picture Comprehension	11
Digit Span	6	Picture Arrangement	10
Vocabulary	9	Block Design	9
Arithmetic	9	Object Assembly	11
Comprehension	8	Digit Symbol	6
Similarities	9		
Total	51	Total	47

Table F6*WAIS-R Scaled Scores for Subject F.*

Verbal Subtests	Scaled Scores	Performance Subtests	Scaled Scores
Information	12	Picture Comprehension	11
Digit Span	12	Picture Arrangement	12
Vocabulary	10	Block Design	10
Arithmetic	7	Object Assembly	9
Comprehension	9	Digit Symbol	6
Similarities	9		
Total	59	Total	48

Table F7*Raw WMS-R Scores for each Subject.*

Subtest	Subject A	Subject B	Subject C	Subject D	Subject E	Subject F
Mental Control	5	6	4	6	5	6
Figural Memory	8	5	8	8	6	8
Logical Memory I	18	13	24	24	17	26
Visual Paired Associates I	8	7	6	9	12	17
Verbal Paired Associates I	14	7	18	16	10	14
Visual Reproduction I	20	17	36	30	38	39
Digit Span	11	15	13	15	9	13
Visual Memory Span	18	16	17	17	18	16
Logical Memory II	10	0	16	21	3	22
Visual Paired Associates II	3	4	5	4	4	6
Verbal Paired Associates II	5	2	5	7	4	6
Visual Reproduction II	25	3	35	24	40	38